Role and importance of regular calibration checks and maintenance of instruments and equipment, and maintenance schedules and procedures

1) Reason/importance of regular calibration checks?

2) Who is responsible to do calibration checks, calibrations or maintenance on laboratory equipment?

3) Importance of implementing and maintaining an equipment maintenance/calibration schedule?

4) List 3 reasons why Work Instructions (WI) and Standard Operating Procedures (SOPs) are important:

I.

II.

III.

5) List x3 consequences if we do not do regular maintenance

I.

II.

III.

Purpose and importance of using certified reference standards or devices

6) List reasons Certified Reference Materials (CRM) are
    a. used and
    b. importance.

Workplace procedures for recording data and reporting results

7) Where is the calibration data and results recorded?

8) What information should an Equipment Logbook have?

9) Provide an example of a procedure/system for each of the following,

   a. Recording data and

   b. Reporting results.

   and

   c. explain on how each would be applied.

Equipment manuals and warranties

10) What are equipment manuals and why are they important?

11) Consequence of doing repairs on equipment that is under warranty?

12) What do you do when equipment has **failed** its calibration?

Basic equipment cleaning, maintenance, scheduling and storage procedures for items of equipment used

13) List the cleaning, maintenance, scheduling, and storage procedures that are performed on a piece of equipment of your choice. (POVA, Balance, pH meter and Microscope)

- Cleaning
- Maintenance
- Storage
- Schedule

Sources of uncertainty in instrument or equipment operation and their control

14) For

I. Analytical Balance

II. POVA

III. Volumetric Flasks

- List Two (2) sources contributing to uncertainty (for each listed above) and how it can be managed

Common sources of faults in the instruments or equipment used and details of their repair

15) List 2 Common sources of faults and repair for each fault.

I.

II.

Common laboratory instruments and equipment requiring calibration checks, and the function of key components, including operating principles, details of the pre-use, calibration and safety checks, and operating procedures

16) Analytical Balance SOP – brief overview of the procedure for,

a. Function of key components
b. Pre-use checks
c. Safety checks
d. Calibration checks
e. Operation

Typical calibration status checks

17) List typical calibration status checks for

- POVA
- Ovens
- Timers
- pH meter

Environmental sustainability issues as they relate to the work task

18) Identify 3 environmental sustainability issues related to working with lab instruments/equipment

-

-

-

Legal, ethical, and work health and safety (WHS) requirements specific to the work task.

19) Explain the legal, ethical and WHS requirements of a Calibration and Maintenance technician-

a. Legal:

b. Ethical:

c. WHS:

Process involved in arranging calibration, repair and/or maintenance of equipment including assessment of instrument repair status and determining if local repair or maintenance is possible and economical.

20) ***Refer to WI-001 Equipment maintenance and repair***

a. Describe the steps you would take to arrange calibration, repair, or maintenance for equipment.
b. How do you select an appropriate a service agent, or personnel
c. What criteria should you consider when evaluating the qualifications of the service agent or personnel?
d. how you ensure that the service or repair performed meets the requirements?
e. Outline the steps you would take to verify and document the service/repair completion.

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Session 7

MSL934008 Maintain instruments and equipment
MSL934009 Apply Quality Systems and Continuous Improvement Processes

Session 6 review

- Common sources of faults and their repair
- Arrange any reordering of consumable stocks and equipment components

Activities:

- **ASSESSMENT TASK 1b: (POVA)** Practical observation, for POVA volume checks continue.
  - *Task "Replace/repair" and cleaning steps to be completed*
- **ASSESSMENT TASK 1c:** Communication-Approved suppliers and service technicians,
- **ASSESSMENT TASK 1e:** Volumetric Glassware

Today's Outcome

- UV-vis spectrophotometry
- Control chart procedure
- Standard verification (inc. QAQC plan)

Activities:

- **ASSESSMENT TASK 1b: (POVA)** Practical observation, for POVA *Task "Replace/repair" and cleaning steps to be completed*
- **ASSESSMENT TASK 1e:** Volumetric Glassware
- Commence control chart readings for **TASK 3** Control Chart (Portfolio) (page 30-31)
- Fixed Wavelength Measurements, Exercise 3. (pages 32-34)

Common sources of faults in the instruments or equipment used and details of their repair

Common Faults		Repair
Wear and Tear	**Sticking** or **jamming** of moving **parts**, resulting in • inaccurate readings or • failure to operate.	Replace part/component and conduct maintenance and/or service (Internal/External) Perform calibration and/or checks to recommission instrument/ equipment (Internal/External)
	Loosening of connections or clips, leading to misalignment of components.	Tighten connections or replace clips and realign components. (Internal) Perform calibration and/or checks to recommission instrument/ equipment
	Physical damage, compromising the integrity of the instrument.	Replace part/component damaged (Internal/External), perform calibration and/or checks to recommission instrument/ equipment

Common sources of faults in the instruments or equipment used and details of their repair

Common Faults		Repair
Electrical/ Electronic Component Failure	**Sensor malfunction** leading to • inaccurate measurements or • Signal/power distortion.	Replace part/component and conduct maintenance and/or service (Internal/External) Perform calibration and/or checks to recommission instrument/ equipment (Internal/External)
	Circuit failure resulting in • intermittent operation, or • complete instrument shutdown.	Replace fuse/component (Internal/External) Perform checks to recommission instrument/ equipment (Internal/External)

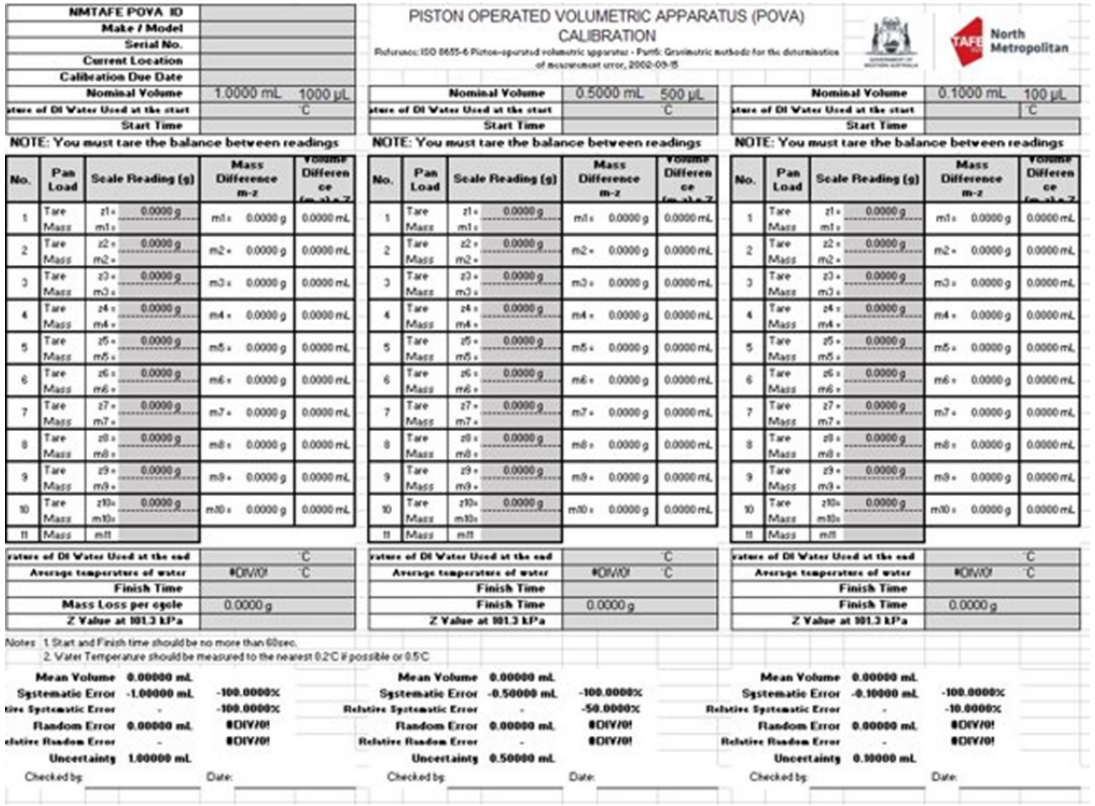
Common sources of faults in the instruments or equipment used and details of their repair

Common Faults		Repair
Improper Handling or Usage causing damage/malfunction	**Rough handling** causing physical damage, misalignment, or distortion of components.	Tighten connections or replace clips and realign components. (Internal) Replace part/component damaged (Internal/External), perform calibration and/or checks to recommission instrument/ equipment. Review procedure and training.
	Exposure to inappropriate conditions or environments (e.g., exceeding specified temperature limits) causing damage or malfunction.	Tag out of service Replace part/component damaged (Internal/External), perform calibration and/or checks to recommission instrument/ equipment. Or replace equipment

Auto-pipette. Piston Operated Volumetric Apparatus (POVA)

ASSESSMENT TASK 1b: (POVA)

- ❑ Practical observation, for POVA volume checks continue.
- ❑ ***Perform*** "Relace/repair" and cleaning steps



PISTON OPERATED VOLUMETRIC APPARATUS (POVA) CALIBRATION

NMTAFE POVA ID	
Make / Model	
Serial No.	
Current Location	
Calibration Due Date	
Nominal Volume	1.0000 mL 1000 µL
Nominal Volume	0.5000 mL 500 µL
Nominal Volume	0.1000 mL 100 µL

NOTE: You must tare the balance between readings

No.	Pan Load	Scale Reading (g)	Mass Difference m-z	Volume Difference
1	Tare Mass	z1 = 0.0000 g m1 =	m1 = 0.0000 g	0.0000 mL
2	Tare Mass	z2 = 0.0000 g m2 =	m2 = 0.0000 g	0.0000 mL
3	Tare Mass	z3 = 0.0000 g m3 =	m3 = 0.0000 g	0.0000 mL
4	Tare Mass	z4 = 0.0000 g m4 =	m4 = 0.0000 g	0.0000 mL
5	Tare Mass	z5 = 0.0000 g m5 =	m5 = 0.0000 g	0.0000 mL
6	Tare Mass	z6 = 0.0000 g m6 =	m6 = 0.0000 g	0.0000 mL
7	Tare Mass	z7 = 0.0000 g m7 =	m7 = 0.0000 g	0.0000 mL
8	Tare Mass	z8 = 0.0000 g m8 =	m8 = 0.0000 g	0.0000 mL
9	Tare Mass	z9 = 0.0000 g m9 =	m9 = 0.0000 g	0.0000 mL
10	Tare Mass	z10 = 0.0000 g m10 =	m10 = 0.0000 g	0.0000 mL
11	Mass	m11		

Average temperature of water	#DIV/0! °C
Finish Time	
Mass Loss per cycle	0.0000 g
Z Value at 101.3 kPa	

Notes: 1. Start and Finish time should be no more than 60sec.
2. Water Temperature should be measured to the nearest 0.2°C if possible or 0.5°C

Mean Volume	0.00000 mL		
Systematic Error	-1.00000 mL	-100.0000%	
Relative Systematic Error	-	-100.0000%	
Random Error	0.00000 mL	#DIV/0!	
Relative Random Error	-	#DIV/0!	
Uncertainty	1.00000 mL		

Mean Volume	0.00000 mL		
Systematic Error	-0.50000 mL	-100.0000%	
Relative Systematic Error	-	-50.0000%	
Random Error	0.00000 mL	#DIV/0!	
Relative Random Error	-	#DIV/0!	
Uncertainty	0.50000 mL		

Mean Volume	0.00000 mL		
Systematic Error	-0.10000 mL	-100.0000%	
Relative Systematic Error	-	-10.0000%	
Random Error	0.00000 mL	#DIV/0!	
Relative Random Error	-	#DIV/0!	
Uncertainty	0.10000 mL		

Checked by: Date:

7.1.14 Greasing the piston and cylinder

The piston or cylinder in the pipette lower part must be regreased after cleaning or decontamination.

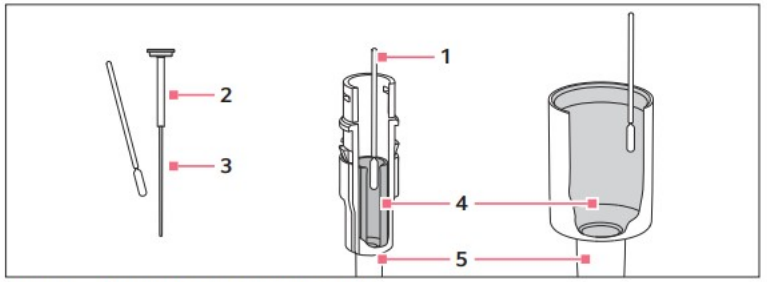


Fig. 7-4: Greasing the piston and cylinder

1	Swab	4	Cylinder
2	Piston ≤ 20 µL	5	Lower part > 20 µL
3	Running surface		

Greasing the piston

Prerequisites:

- For volumes ≤ 20 µL
- The pipette lower part has been disassembled.

1. Apply a small amount of grease to the swab.
2. Apply a thin layer of grease to the piston running surface. The pipette lower part can be reassembled.

** Refer to specific manufacturer manual*

Assessment 1c - Communication - Approved suppliers and service technicians

Supplier communication- Part A

The assessment is comprised of 2 parts (Part A and Part B).

Equipment to be considered –

- Analytical balance (failed Repeatability or Monthly Single Point check),
- UV-Vis (lamp replacement, cuvette),
- pH Meter (electrode, fill solution, buffers).

PART A

1. List the steps required when dealing with faulty equipment within the laboratory.
2. Fill in the checklist/template provided and upload.

PART B

Communicate with NMTAFE Technical Support Officer who will contact the approved supplier about the required parts for equipment.

Send a 'formal **email'** to the NMTAFE Technical Support Officer requesting to order parts for a specific laboratory equipment. - ***(Upload a copy of the email)***

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Volumetric Glassware Verification
AS2162.1-1996; ASTM E 542: 2022; ISO 4787: 2021

CALCULATION FOR THE CALIBRATION CHECK OF: VOLUMETRIC FLASKS

Date:		Location:	
Glassware Identification:		Balanced used:	
Performed by:		Checked by:	

Nominal Volume Dispensed (mL):			Water Density:		
Replicate No.	Empty volumetric glassware$^{(z)}$	Volumetric glassware + dispensed $^{(m)}$	Weight Dispensed $^{(z-m)}$		
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
Water Temp. ^{0}C:		5		±	g $^{95\%}$
z factor:		Calculated Vol.Dispensed:		±	mL $^{95\%}$
Nominal Accuracy Criteria (+/-):	1.0%	Accuracy (%):			
Tolerance for this apparatus (+/-):	1.0%	Tolerance (%):			
Comments:			Thermometer used:		

Assessment Task 1e Volumetric Glassware

Perform verification of the calibrated volume of 2 flasks,

- *1x 100ml flask and*
- *1x 50ml flask.*

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

What is a Spectrophotometer?

A spectrophotometer is an instrument that measures how much light is absorbed by a water sample as light passes through it.

After adding chemical reagents to a water sample, those reagents react with analyte(s) to form a color complex. Spectrophotometers then use internal calibrations to equate that color to the concentration of the parameter being measured.

Spectrophotometry is one of the most common and useful methods of quantitative analysis of many water parameters in various industrial and municipal applications.

Beer-Lambert Law

The fundamental principle behind spectrophotometry is the **Beer-Lambert** Law, which states that the concentration of a sample is directly proportional to the amount of light absorbed by the sample.

When a beam of light passes through a sample, some of the light is absorbed, and the remainder is transmitted.

The spectrophotometer measures the amount of light that is transmitted and calculates the amount that was absorbed.

https://chemistrytalk.org/beer-lambert-law/

Beer-Lambert Law

The law is expressed by the equation: $A = \varepsilon * c * l$

Where:

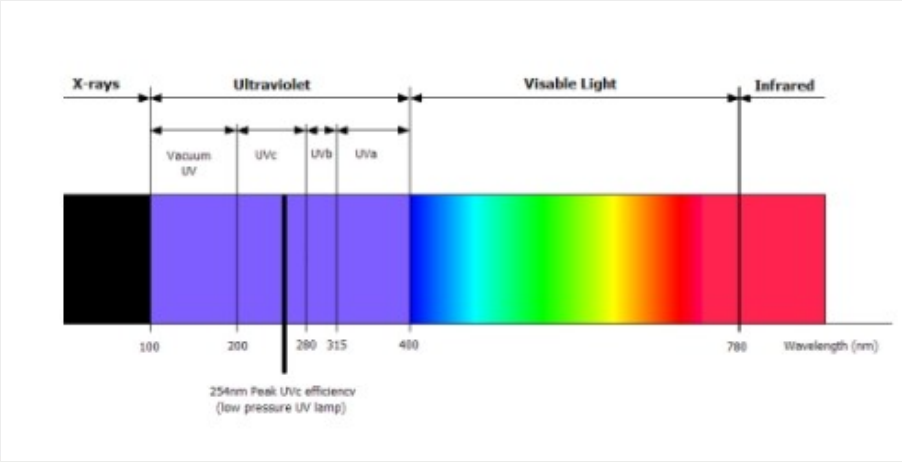
- **A** is the absorbance of the solution, a dimensionless quantity that indicates how much light is absorbed by the sample.
- **ε** (epsilon) is the molar absorptivity or molar extinction coefficient, a constant that describes how strongly a substance absorbs light at a particular wavelength. It has units of L/(mol cm) and depends on the specific substance and the wavelength of light.
- **c** is the concentration of the absorbing substance in the solution, measured in mol/L (molarity).
- **l** is the path length of the cuvette through which the light passes, measured in centimetres.

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Examples of UV Vis Cuvettes for Spectrophotometers

Cuvette	Wavelength*	Cost
Plastic	340-900nm	$
Plastic (DNA)	230-900nm	$
Glass	320-2500nm	$$
Quartz (UV)	190-2500nm	$$$
Quartz (IR)	220-3500nm	$$$$



**Wavelength range specifications may vary based on manufacture and product*

UV Vis Cuvettes for Spectrophotometers

Plastic, Glass and Quartz Cuvettes

They have some differences in properties and applications:

- **Plastic cuvettes** (made from Polymethylmethacrylate (PMMA) and Polystyrene (PS) are used for
  - Measurements in the visible range from 340 to 900 nm.
  - Disposable UV-transparent cuvettes may be an economical alternative to standard quartz or glass rectangular cells
  - Eliminate the risk of cross-contamination with traditional glass or quartz reusable cuvettes
  - Improve productivity and reduce cost - eliminate the need for cleaning cuvettes for re-use

UV Vis Cuvettes for Spectrophotometers

Glass cuvettes (made from optical glass) are used for

- Measurements in the visible range from 320 to 2500 nm.
- They might not be suitable for samples that contain strong acids or bases or for aggressive chemical reactions.
- Are more prone to scratching and breakage compared to quartz cuvettes
- Less expensive than quartz cuvettes.

Quartz cuvettes (cuvettes are made from high-purity quartz material)

- Deliver precise results in the whole UV and visible range from 190 to 2500 nm.
- Are more chemically resistant than glass cuvettes. They can withstand a wider range of chemicals and are often used for measurements involving corrosive or reactive substances.
- Quartz cuvettes are more **durable** and **scratch-resistant** compared to glass cuvettes
- Quartz cuvettes are more expensive due to the cost of the high-purity quartz material and the manufacturing process.

The choice between plastic, glass and quartz cuvettes depends on the specific requirements of your experiment or analysis

Assessment Task 3

OFFICIAL

Government of Western Australia
North Metropolitan TAFE

Control Chart Procedure

1. INTRODUCTION

Control charts are an essential tool in laboratory quality management systems, enabling the monitoring and control of processes to ensure consistency (precision) and reliability (accuracy) of results.

2. SCOPE

This document describes statistical quality control (SQC) procedures for monitoring the performance of quantitative tests carried out routinely in NMTAFE Laboratory.

3. PRINCIPLE OF THIS PROCEDURE

A reference sample is analysed, according to the method that is to be controlled, at least 20 times by as many different analysts (as is practicable).

From the results recorded the mean value, standard deviation (sd/σ), warning (2*sd) and action limits (3*sd) are statistically calculated. These values are used in preparing the control chart. The reference sample is then tested at a scheduled frequency and the results graphed.

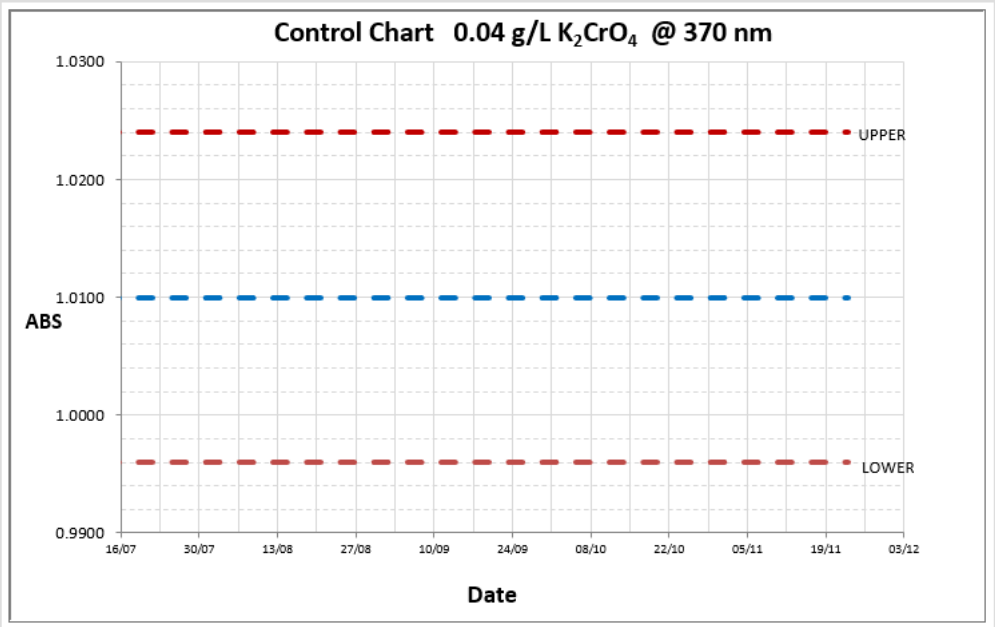
Correct interpretation of the charts should show both sharp and gradual changes in the accuracy of the mean and precision of the test.

4. REFERENCE MATERIAL

Choose the reference material (quality control or QC sample), based on the following points:

(a) Its long-term stability.

(b) There is a sufficient quantity of the material available.



Activities

- Assessment Task 3 (page 30-31)
- Fixed Wavelength Measurements, Exercise 3. (pages 32-34)

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Quality Control Presentation and QAQC plan

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Qualification national code and title:	MSL40122 Certificate IV in Laboratory Techniques
Delivery Period:	Semester 2 2024
Cluster Name (if applicable)	Apply Quality Systems

National ID	Name of unit
MSL934008	Maintain instruments and equipment
MSL934009	Apply Quality Systems and Continuous Improvement Processes

Session 2 Review

QMS Jeopardy!!

Quality Management Systems Jeopardy! Here are some categories related to quality management systems activities:

Select your category 😋

1) Standards & Frameworks
2) Quality Tools & Techniques
3) Continuous Improvement
4) Quality Assurance vs. Quality Control
5) Process Mapping & Documentation

Session 2 Review

Corrective and Preventative Action Procedure (PDCA)

- Root Cause Analysis
- Quality improvement Tools

List 3x Quality improvement Tools

- **Equipment verification**

- **Introduction to Balances**

Today's Outcomes

Analytical Balances

- ❑ Safety requirements
- ❑ Work Instruction-Prestart, Operating a balance
- ❑ Calibration requirements
- ❑ Perform Calibration checks, single point and repeatability

(Assessment Task 1a Practical observations).

Equipment verification, Equipment registers and calibration schedules

In class activity: Develop a 'Maintenance and Calibration Schedule' for the following equipment in your laboratory, listed below

Analytical Balance, Variable Pipette, pH meter, Drying oven, Timers, Volumetric glassware and Spectrophotometer

Analytical Balances

- ❑ Safety requirements
- ❑ Prestart
- ❑ Operating procedure
- ❑ Calibration requirements

GOVERNMENT OF WESTERN AUSTRALIA

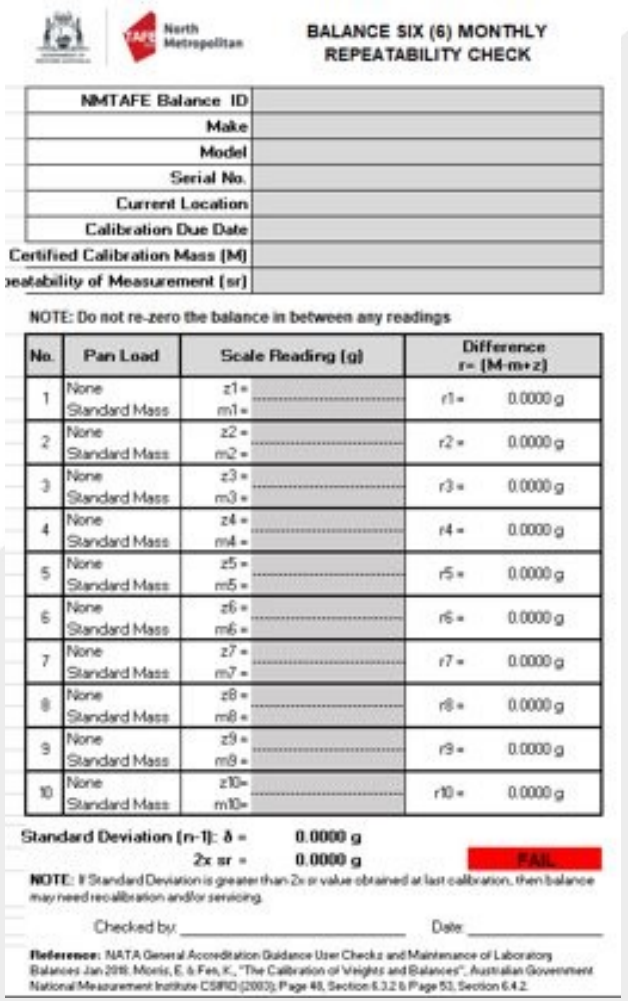
TAFE WA North Metropolitan

6 Monthly Calibration Checks

Repeatability

Weigh *same mass* **10** times

Repeatability check at or near the **maximum** balance capacity and greater than or equal to 80% of balance capacity.



BALANCE SIX (6) MONTHLY REPEATABILITY CHECK

NMTAFE Balance ID	
Make	
Model	
Serial No.	
Current Location	
Calibration Due Date	
Certified Calibration Mass (M)	
Repeatability of Measurement (sr)	

NOTE: Do not re-zero the balance in between any readings

No.	Pan Load	Scale Reading (g)	Difference r= (M-m+z)
1	None Standard Mass	z1 = m1 =	r1 = 0.0000 g
2	None Standard Mass	z2 = m2 =	r2 = 0.0000 g
3	None Standard Mass	z3 = m3 =	r3 = 0.0000 g
4	None Standard Mass	z4 = m4 =	r4 = 0.0000 g
5	None Standard Mass	z5 = m5 =	r5 = 0.0000 g
6	None Standard Mass	z6 = m6 =	r6 = 0.0000 g
7	None Standard Mass	z7 = m7 =	r7 = 0.0000 g
8	None Standard Mass	z8 = m8 =	r8 = 0.0000 g
9	None Standard Mass	z9 = m9 =	r9 = 0.0000 g
10	None Standard Mass	z10= m10=	r10 = 0.0000 g

Standard Deviation (n-1): δ = 0.0000 g

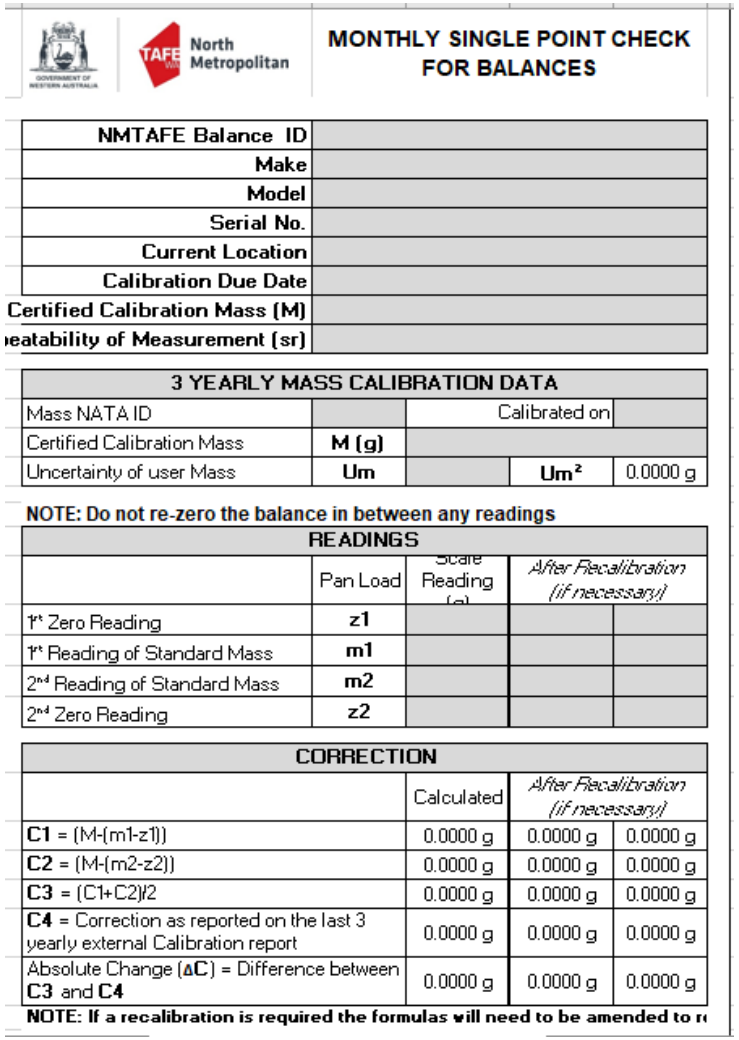
2x sr = 0.0000 g FAIL

NOTE: If Standard Deviation is greater than 2x sr value obtained at last calibration, then balance may need recalibration and/or servicing.

Checked by: _____ Date: _____

Reference: NATA General Accreditation Guidance User Checks and Maintenance of Laboratory Balances Jan 2018. Morris, E. & Fes, K., "The Calibration of Weights and Balances", Australian Government National Measurement Institute CSIRO (2003), Page 48, Section 6.3.2 & Page 53, Section 6.4.2.

Monthly Calibration Checks- Single Point



MONTHLY SINGLE POINT CHECK FOR BALANCES

NMTAFE Balance ID	
Make	
Model	
Serial No.	
Current Location	
Calibration Due Date	
Certified Calibration Mass (M)	
eatability of Measurement (sr)	

3 YEARLY MASS CALIBRATION DATA				
Mass NATA ID		Calibrated on		
Certified Calibration Mass	M (g)			
Uncertainty of user Mass	Um		Um^2	0.0000 g

NOTE: Do not re-zero the balance in between any readings

READINGS				
	Pan Load	Scale Reading (g)	*After Recalibration (if necessary)*	
1st Zero Reading	z1			
1st Reading of Standard Mass	m1			
2nd Reading of Standard Mass	m2			
2nd Zero Reading	z2			

CORRECTION			
	Calculated	*After Recalibration (if necessary)*	
C1 = (M-(m1-z1))	0.0000 g	0.0000 g	0.0000 g
C2 = (M-(m2-z2))	0.0000 g	0.0000 g	0.0000 g
C3 = (C1+C2)/2	0.0000 g	0.0000 g	0.0000 g
C4 = Correction as reported on the last 3 yearly external Calibration report	0.0000 g	0.0000 g	0.0000 g
Absolute Change (**ΔC**) = Difference between **C3** and **C4**	0.0000 g	0.0000 g	0.0000 g

NOTE: If a recalibration is required the formulas will need to be amended to r

Monthly Single Point check at or near the **maximum** balance capacity.

- greater than or equal to 80% of balance capacity.

Operating an Analytical Balance

Mass/Weight Checks			
Balance Capacity (g)	**80% of Capacity (g)**	**Mass (g) that could be used ≥80%**	**Ideal mass to use for check**
120	96	100 to 120	100g
220			200g
310		to 310	250/ 300g
600		480 to 600	500g
1100		900 to 1100	1000g

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

MONTHLY SINGLE POINT CHECK FOR BALANCES

NMTAFE Balance ID	
Make	
Model	
Serial No.	
Current Location	
Calibration Due Date	
Certified Calibration Mass (M)	
Repeatability of Measurement (sr)	

3 YEARLY MASS CALIBRATION DATA				
Mass NATA ID		Calibrated on		
Certified Calibration Mass	M (g)			
Uncertainty of user Mass	Um		Um^2	0.0000 g

NOTE: Do not re-zero the balance in between any readings

READINGS				
	Pan Load	Scale Reading (g)	*After Recalibration (if necessary)*	
1st Zero Reading	z1			
1st Reading of Standard Mass	m1			
2nd Reading of Standard Mass	m2			
2nd Zero Reading	z2			

CORRECTION			
	Calculated	*After Recalibration (if necessary)*	
C1 = (M-(m1-z1))	0.0000 g	0.0000 g	0.0000 g
C2 = (M-(m2-z2))	0.0000 g	0.0000 g	0.0000 g
C3 = (C1+C2)/2	0.0000 g	0.0000 g	0.0000 g
C4 = Correction as reported on the last 3 yearly external Calibration report	0.0000 g	0.0000 g	0.0000 g
Absolute Change (**ΔC**) = Difference between **C3** and **C4**	0.0000 g	0.0000 g	0.0000 g

NOTE: If a recalibration is required the formulas will need to be amended to r

1

2

3

Zero reading

Weight reading

NGB
total weighing solutions

Calibration Results

Certificate No : 2169752-13-F File : 2169752-13-F.docx

Serial numbers of reference masses used in this calibration: 7710, 18408 Where this report lists multiple weights of the same nominal value these weights may be uniquely identified by a marked serial number or additional marking to differentiate weights. The differentiating mark may be a simple dot, asterisk or letter marked in a prominent location. This differentiating mark (if applicable) is shown in the table below in the Nominal Value or S/N or Markings columns.

Nominal	S/N or Markings	Measured value (gram)	Measurement uncertainty
200g	9411	200.000 3	0.20mg
100g	29109	99.999 6	0.10mg
50g	29109	49.999 96	0.06mg
20g•	29109	19.999 14	0.035mg
20g	29109	19.999 07	0.035mg
10g	29109	9.998 94	0.025mg
2g•	29109	1.999 93	0.015mg
2g	29109	1.999 92	0.015mg
1g	29109	0.999 34	0.015mg

calibrate single point

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

3 YEARLY BALANCE CALIBRATION DATA				
Date of last calibration				
Results & Calculations	U	U^2	sr	$(1.6sr)^2$
		0		0
	Um	$(Um)^2$		
		0		

SINGLE POINT CHECK		
Single point Check complies if: $\Delta C < \sqrt{U2 + (1.6Sr)2 + Um2}$	0.0000	FAIL

NOTE: Determination compliance. If Absolute Change is less than or equal to Single Point Check value, the balance complies.

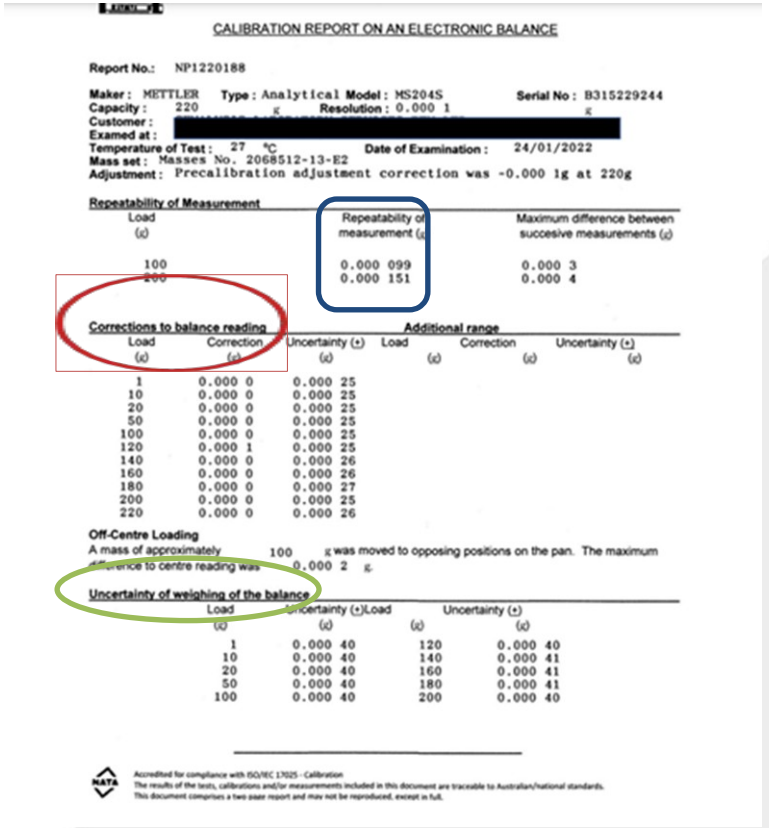
LIMIT OF PERFORMANCE		
LOP = $2.26\ S_w + \lvert Corr_w \rvert + U(C_{cal})$	0.0000	FAIL

NOTE: If Absolute Change is less than or equal to the Limit of performance value, the balance complies. If this fails the balance may require servicing and recalibrating.

Checked by: _____ Date: _____

Estimate of Accuracy and Departure from Nominal Value.

Reference: NATA General Accreditation Guidance User checks and maintenance of laboratory balances Jan 2018



CALIBRATION REPORT ON AN ELECTRONIC BALANCE

Report No.: NP1220188

Maker: METTLER Type: Analytical Model: MS204S Serial No: B315229244
Capacity: 220 g Resolution: 0.000 1 g
Customer: [redacted]
Examed at:
Temperature of Test: 27 °C Date of Examination: 24/01/2022
Mass set: Masses No. 2068512-13-E2
Adjustment: Precalibration adjustment correction was -0.000 1g at 220g

Repeatability of Measurement

Load (g)	Repeatability of measurement (g)	Maximum difference between succesive measurements (g)
100	0.000 099	0.000 3
200	0.000 151	0.000 4

Corrections to balance reading / Additional range

Load (g)	Correction (g)	Uncertainty (±) (g)	Load (g)	Correction (g)	Uncertainty (±) (g)
1	0.000 0	0.000 25			
10	0.000 0	0.000 25			
20	0.000 0	0.000 25			
50	0.000 0	0.000 25			
100	0.000 0	0.000 25			
120	0.000 1	0.000 25			
140	0.000 0	0.000 26			
160	0.000 0	0.000 26			
180	0.000 0	0.000 27			
200	0.000 0	0.000 25			
220	0.000 0	0.000 26			

Off-Centre Loading
A mass of approximately 100 g was moved to opposing positions on the pan. The maximum difference to centre reading was 0.000 2 g.

Uncertainty of weighing of the balance

Load (g)	Uncertainty (±) (g)	Load (g)	Uncertainty (±) (g)
1	0.000 40	120	0.000 40
10	0.000 40	140	0.000 41
20	0.000 40	160	0.000 41
50	0.000 40	180	0.000 41
100	0.000 40	200	0.000 40

Accredited for compliance with ISO/IEC 17025 - Calibration
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
This document comprises a two page report and may not be reproduced, except in full.

calibrate single point

Out of Class Activities

- Complete Work Instruction Procedure Summary for analytical balances
- View video, ‘How to Use an Analytical Balance’
- Enter Calibration checks
  - monthly single point and
  - repeatability

  into spreadsheets, ready for review next week

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Equipment Registers and Calibration Schedules

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Apply Quality Systems
Lecture 1

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

What is Quality?

Quality is a term that is often used inaccurately. The term can cause confusion because it has TWO different meanings:

1. high grade, superior excellence
2. a characteristic, property or attribute.

It is the second meaning of quality that is used in the context of laboratory testing.

What is Quality?

- The ability to consistently produce the same product (or result) to meet the same specifications time after time!
  - *Accuracy and precision*
  - *repeatability*
  - *Note: stronger, purer, higher assay, or higher yield . . . is not necessarily better!*

- Quality improvement often starts with reducing the variability of results.
- Basic quality requirements are summed up in AS 17025.

Check your understanding of Quality. Which is correct?

- ❑ Quality always means the highest grade.
- ❑ Quality is a characteristic or attribute.
- ❑ ‘Fitness for Purpose’ describes our approach to quality.
- ❑ The more decimal places in a test result the better!
- ❑ The Quality Officer is the only person responsible for quality

What is a quality assurance?

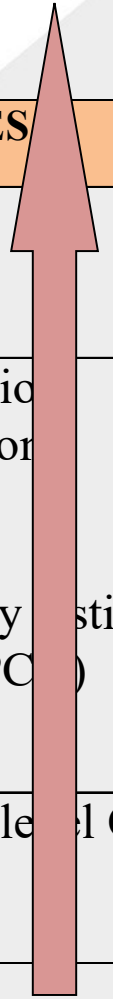
- Quality assurance is the system by which the laboratory manages its quality aspects in a systematic, organized manner.
- Quality assurance guarantees and guides (through documentation) the way the organization operates.
  - organizational authority,
  - responsibilities and accountability,
  - procedures and practices.
  - the quality of the product
  - customer satisfaction
  - Through a process of continuous improvement

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

The Quality Hierarchy

	ACTIVITIES PERFORMED	AGENCIES
Quality System	Comprehensive and coordinated guide to meet quality objectives	AS 17025 ISO 9000 / 9001 GLP
Quality Assurance	Planned, documented and systematic activities to assure that an organization fulfills it's goals regarding quality. Maintenance schedules	CLIA '88 certificatio JACHO accreditation CAP accreditation DEP certification External proficiency sting activities (e.g. RCPC)
Quality Control	Operational techniques to fulfill requirements for quality and regulatory compliance	e.g.Organizational-le l QC activities



Quality Systems in the laboratory.

A **quality management system** (**QMS**) is a collection of business processes focused on consistently meeting customer requirements and enhancing their satisfaction.

It is aligned with an organization's purpose and strategic direction. Specifically, laboratories use ISO/IEC 17025 to implement a quality system aimed at improving their ability to consistently produce valid results, it is also the basis for accreditation from an accreditation body.

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

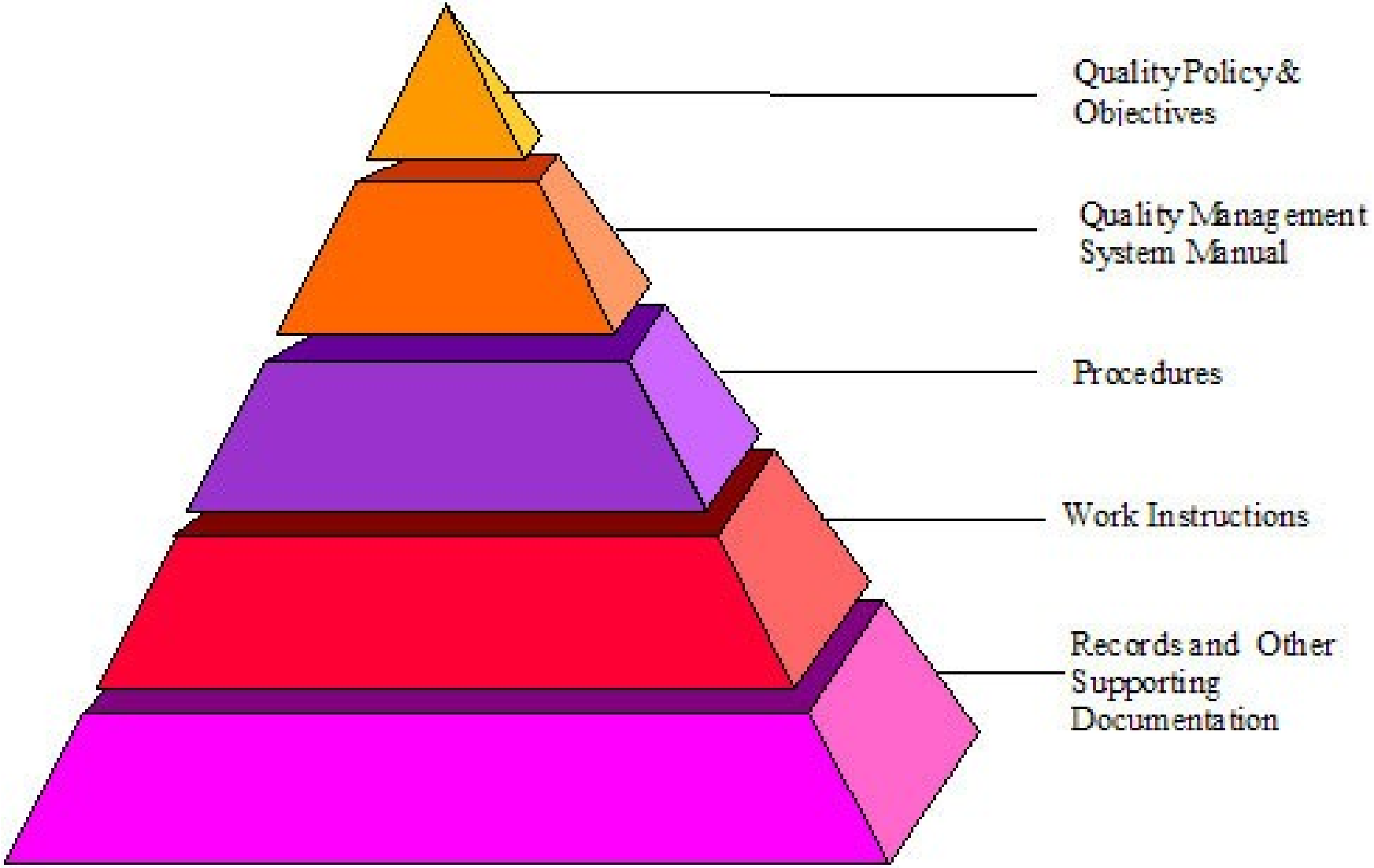
Documents and Records Required for an ISO/IEC 17025 Management System

When laboratories are going for accreditation, there are specific ISO/IEC 17025:2017 documentation requirements that need to be fulfilled. These documents are used to design and develop testing and calibration laboratories. There are several categories of such requirements for better understanding and defining quality systems in laboratory as per the ISO/IEC 17025:2017 standard. The document categories are as following:

- Policies
- Documents
- Procedures
- Records
- Processes
- Review

– Introduction to AS ISO17025 [i2i (saiglobal.com)]

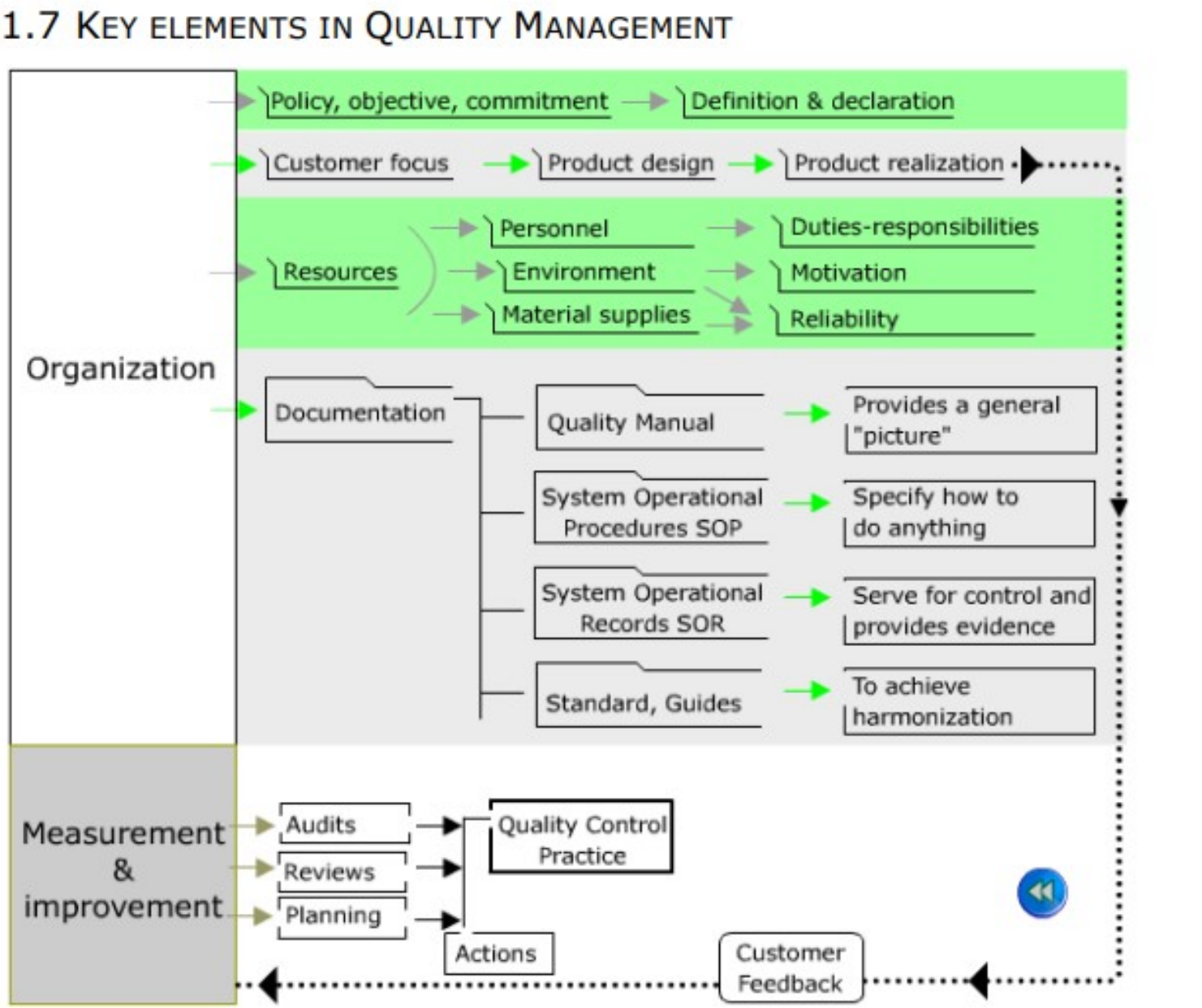
Quality Management System



- **Quality Management System**

Overview:

- Quality Policy
- Quality Manual
- Procedures
- SOP
- Reporting
- Audits



GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

International Standards for Quality Management Systems

- The ISO 9000 series is a family of standards for quality management systems
- Is maintained by the International Organization for Standardization (ISO)
- Is designed to help organizations ensure that they meet the needs of customers and other stakeholders, while meeting regulatory requirements related to the product
- AS 17025 applies specifically to laboratory management systems is equivalent to ISO 9001

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Some of the requirements in AS 17025 include:

- a set of procedures that cover all key processes in the business;
- monitoring of all measurement processes to ensure they are producing quality
- keeping proper documents and records;
- checking outgoing results for errors, with appropriate corrective action where necessary; and
- customer's quality requirements, customer satisfaction,
- Continuous self evaluation and improvement

ISO/IEC 17025 Requirements
The customer as a partner:

- **Laboratories must**
  - develop & maintain *customer communication*
  - correctly *identify* customer *needs*
  - ensure *capability* to meet identified needs
  - use *test methods* appropriate for their intended use

- **Test Methods must**
  - satisfy (identified) *purpose* of testing (fit for purpose)
  - meet specified *customer requirements*
  - have appropriate *validation*
  - produce *"traceable"* results with stated *uncertainty*

Accreditation

- NATA provides independent confirmation that organisations meet the requirements of ISO 9001.
- Laboratories are therefore "accredited" under ISO/IEC 17025, rather than "certified" or "registered" (c.f. ISO 9000 series).
- In Australia, NATA (National Association of Testing Authorities) is the national authority
- Over a million organisations worldwide are independently accredited, making ISO 9001 one of the most widely used management tools in the world today.

- NATA Accreditation https://nata.com.au/

- General Accreditation Criteria

https://nata.com.au/news-and-events/publications-library/#17025

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Quality: Taking it Personally

The bottom line is that if people are empowered, entrusted and enabled to produce quality work, they will take pride and joy in doing so. Conversely, and simultaneously, people who take pride and joy in their work will produce quality

- W Edwards Deming *Out of Crisis*

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Shewhart/Deming Cycle

Continuous improvement is an important principle that drives the quality cycle of planning, implementation, assessment, and decision making

Plan: identify what can be improved and what change is needed

Do: implement the design change

Check: measure and analyse the process or outcome

Act: if the results are not as hoped for

Without a Laboratory Quality System…

too many mistakes can make analysis very costly; due to expenses caused by wrong decisions, or

- repeating analysis of samples
- investigation of problems
- loss of productivity
- revision of procedures
- loss of good reputation

Eg see PAN pharmaceuticals recall 2003

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Prevention is better than the cure!

'It costs less to prevent a problem than it does to correct it'

A technician in the laboratory can contribute to quality by:

- competently following analytical procedures
- accurate reporting of results and documentation
- maintain equipment, report faults
- report WHS and environmental hazards
- work in a safe and timely manner

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Quality documentation - examples

- AS 2830.1 Good Laboratory Practice
- AS 17025 General requirements for the competence of testing and calibration laboratories
- Royal college of pathologists – proficiency testing results

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Apply Quality Systems
Lecture 2

Tools for quality

Session 1 Review

Quality Systems in the laboratory.

- **Introduction to AS ISO17025**
- **NATA**
  - General Accreditation Criteria
- **Quality Management Systems**
  - Quality Policy
  - Quality Manual
  - Procedures
  - SOP
  - Reporting
  - Audits
- **Exercise 1**

Today's Session

- Quality Policy
- Corrective and Preventative Action Procedure
  - Root Cause Analysis
- Quality improvement principles and Tools

- Equipment Registers and Calibration Schedules introduction
- Equipment verification
  - Introduction to Balances

Quality Policy

Government of Western Australia
North Metropolitan TAFE

Quality Policy

NMT Laboratory is committed to providing quality services. We have developed our expertise since our establishment and our aim is to achieve a high standard laboratory service for all our customers.

Our commitment to quality is focussed on the following framework: -

- To use the disciplines of ISO 9001 to develop and maintain the processes needed to produce a level of management to a consistent standard of quality and at a competitive cost.
- To foster good relationships with clients by effective communication with clients and encouraging feedback.
- To continually improve the effectiveness of the Integrated Management System.
- To document and measure quality objectives and targets through internal audit and management review.
- To deliver services in accordance with the specifications and requirements of our clients.
- That every employee constantly aims to improve the overall quality of Company products and services.

The Senior Management Team has the ultimate responsibility to demonstrate leadership with respect to the quality management system and take accountability for the effectiveness of the system.

The Senior Management Team will also support other relevant management roles to demonstrate their leadership as it applies to their area of responsibility. Senior Management will also ensure the integration of the quality management system into the organisation's business processes and promote the use of a systematic and risk- assessed approach.

Every staff member has the responsibility to ensure that the intentions of this policy statement are understood, applied, and maintained within their own activity area.

Joe Bloggs

Joe Bloggs
Managing Director

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Problem solving

- Organizations tend to focus on day to day problems that crop up
- Often these problems disappear, only to crop up again
- This is because the ***root cause*** of the problem has not been addressed
- This leads to rework

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Root Cause Analysis

- The ‘firefighting’ approach to problem solving, (ie seeking an instant solution) is seldom successful
- If we understand *what* is happening, then we should also understand *why* the solution will be effective
- Solutions will be effective only if we understand the *root cause* of the problem
- The 5 Whys

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Non-Conformance Report (NCR)

Non-Conformance Report (NCR)

This template is designed to ensure a systematic approach to capturing, analysing, and resolving non-conformances.

I. General Information:

Non-Conformance Report Number	YYYYMMDD-#
Report Date:	DD/MM/YYY
Reported By:	
Contact Information:	
Department:	
Location: (Circle) Work Area: (Circle) Room #:	East Perth / Northbridge Administration / Laboratory / Sample Receipt
Date of Non-Conformance:	DD/MM/YYY

II. Non-Conformance Details:

Description of Non-Conformance:

[Provide a detailed description of the problem, including the product, process, or system affected] [Attach any supporting documents, photographs, or additional information relevant to the non-conformance.]

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Non-Conformance Report (NCR)

Non-Conformance Category: *Circle the appropriate category.*

Quality / Safety / Environment

Severity Level: *Circle severity level.*

Critical / Major / Minor

III. Root Cause Analysis:

Investigation Date: DD/MM/YYY

Identification of Root Cause(s):

[Identify the root cause(s) of the non-conformance.]

Use and attached Quality tools used during investigation- Group Brainstorming, Fishbone Diagram, 5 Whys, or any other applicable method.

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Non-Conformance Report (NCR)

Non-Conformance Report (NCR)

IV. Corrective Action Plan: (PDCA)

Proposed Corrective/Preventative Actions: (Plan & Do)

List the Corrective/ Preventative Actions: (CAPA)	Responsible Parties:	Timeline for Implementation:
Actions to address the NC	[Specify individuals or departments responsible for implementing each CAPA.]	[Provide deadlines for each CAPA.]

V. Effectiveness Check of Corrective Actions: (Check)

Verification Date:

Verification Method:

[Describe how the effectiveness of corrective actions will be verified. This could include re-inspection, auditing, testing, or other methods.]

[Attach any supporting documents, photographs, or additional information relevant to the PDCA.]

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Non-Conformance Report (NCR)

Non-Conformance Report (NCR)

VI. Review and Approval: (Check)

Review Date:

Reviewed By:

Approval Signature:

VII. Follow-Up: (Act)

Follow-Up Date:

Status of Corrective and Preventive Actions:

List of Corrective/ Preventative Actions: (CAPA)	Status:
	Indicate whether it has been completed or is in progress.

VIII. Attachments:

[List and attach any supporting documents, photographs, or additional information relevant to the non-conformance.]

PDCA Cycle - example

- Assessment of a control chart identifies an out of control situation and a possible remedy from which a **PLAN** can be developed
- **DO** - The plan is then implemented
- **CHECK** – The control chart is checked to see whether the plan has resulted in improvement
- **ACT** - Action is taken on the basis of the success or otherwise

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Root Cause Analysis

Non Conformance: Sampling records from a remote site have been filled out using pencil; not with black ink as required.

Why? The correct materials were not available *(and as this work was done out of hours, there was no chance to obtain an ink pen from local stores).*

Why? Technicians forgot to collect the company supplied ink pens before leaving to do the sampling.

Why? The remote sampling checklist was not used to determine whether all essential materials had been packed.

Why? The sampling checklist is a separate form from the other documentation and was not printed with the Chain of Custody (COC) form.

ACTION: In future it will be company policy that a sampling checklist must be completed and signed and submitted before leaving on remote sampling jobs.

Seven Tools of Quality

- Ishikawa summarised seven visual tools of quality to help analyze and interpret data.
- These (and other) tools are used worldwide.
- Visual Aids make statistical and quality control more comprehendible.

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Quality related problems in the laboratory can be addressed and solved using fundamental quantitative tools.

Ishikawa's Seven Tools of Quality

- Check sheet
- Control chart
- Flowchart
- Histogram
- Cause and effect (fishbone) diagram
- Scatter plot
- Pareto chart

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Checklist

LABORATORY SAFETY INSPECTION CHECKLIST

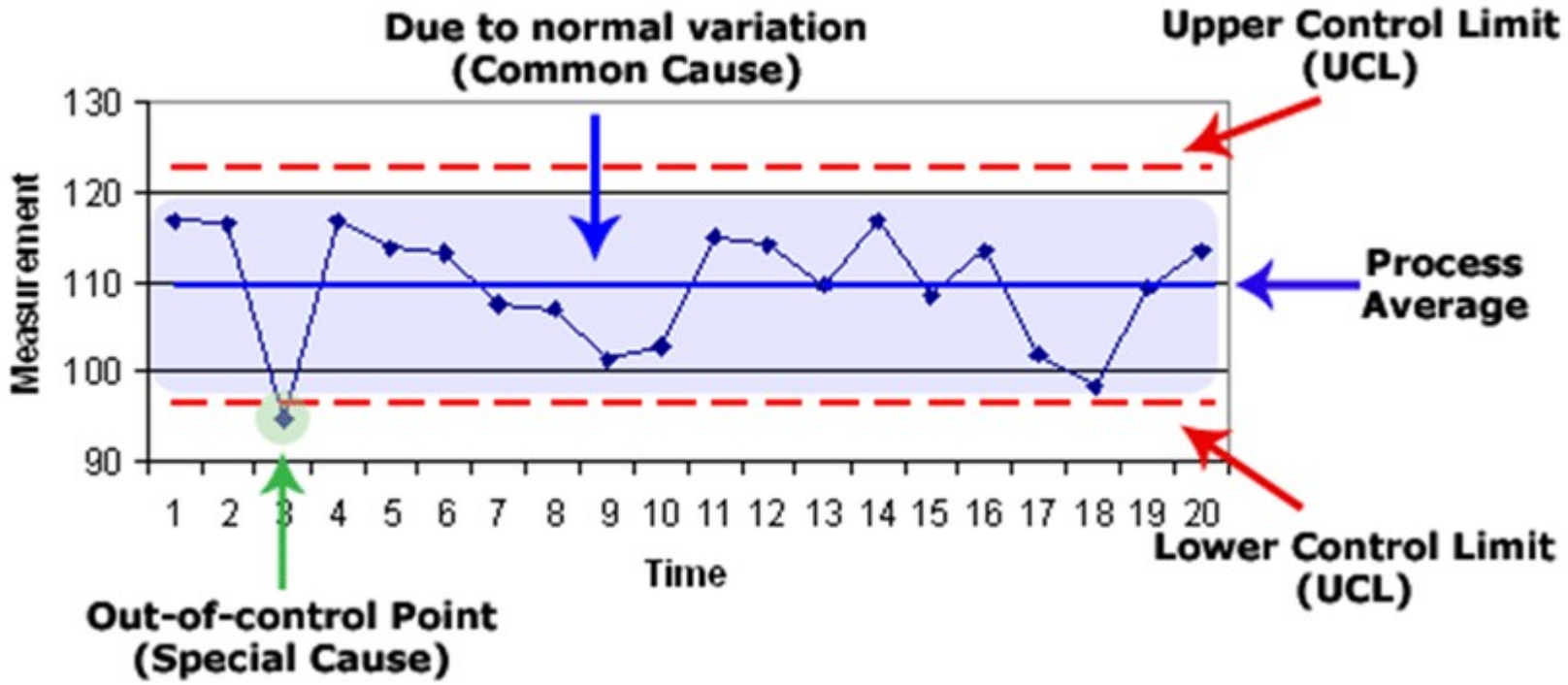
Note: D = daily, W = weekly, M = monthly, T = once a term

Frequency Note				Descriptor	Check Mark	
D	W	M	T		Yes	No
				First-aid Equipment		
D				1. Is the first-aid box fully equipped and easily accessible?		
	W			2. Is the eye wash bottle clean and the distilled water replaced?		
				Fire-fighting Equipment		
	W			1. Is the CO_2/dry powder fire extinguisher serviceable and fully charged for immediate use?		
	W			2. Is the fire blanket available for immediate use?		
	W			3. Are the sand buckets dry and free from rubbish?		
				Personal Protective Equipment		
	W			1. Are there sufficient safety glasses available for immediate use?		
	W			2. Are the safety glasses clean, free from scratches and in good condition?		
	W			3. Is the safety screen available for immediate use?		
	W			4. Is the face shield available for immediate use?		
		M		5. Is the safety glasses for laser protection (if any) available for immediate use?		
		M		6. Have the safety spectacles/goggles, face shield and safety screen been cleaned with detergent/disinfectant?		
	W			7. Are laboratory gowns and protective gloves (e.g. disposable plastic gloves, chemical/heat resistant gloves and leather gloves for animal handling) available for immediate use?		
	W			8. Is the respirator available for immediate use?		
				Electrical Supply		
	W			1. Are plugs, sockets and switches securely screwed, without cracks and free from signs of overheating?		
	W			2. Are electrical fittings free from loose/exposed wires?		
			T	3. Does the residual current device operate when the test button is pressed?		
D				4. Is the main switch switched off by the end of the school day (if applicable)?		
				Gas Supply		
	W			1. Are Bunsen burners maintained in good condition (e.g. the barrels are free from obstructions, the collars are not stuck, etc.) and the tubing free from any signs of deterioration?		
D				2. Have all gas taps been closed by the end of the school day?		

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

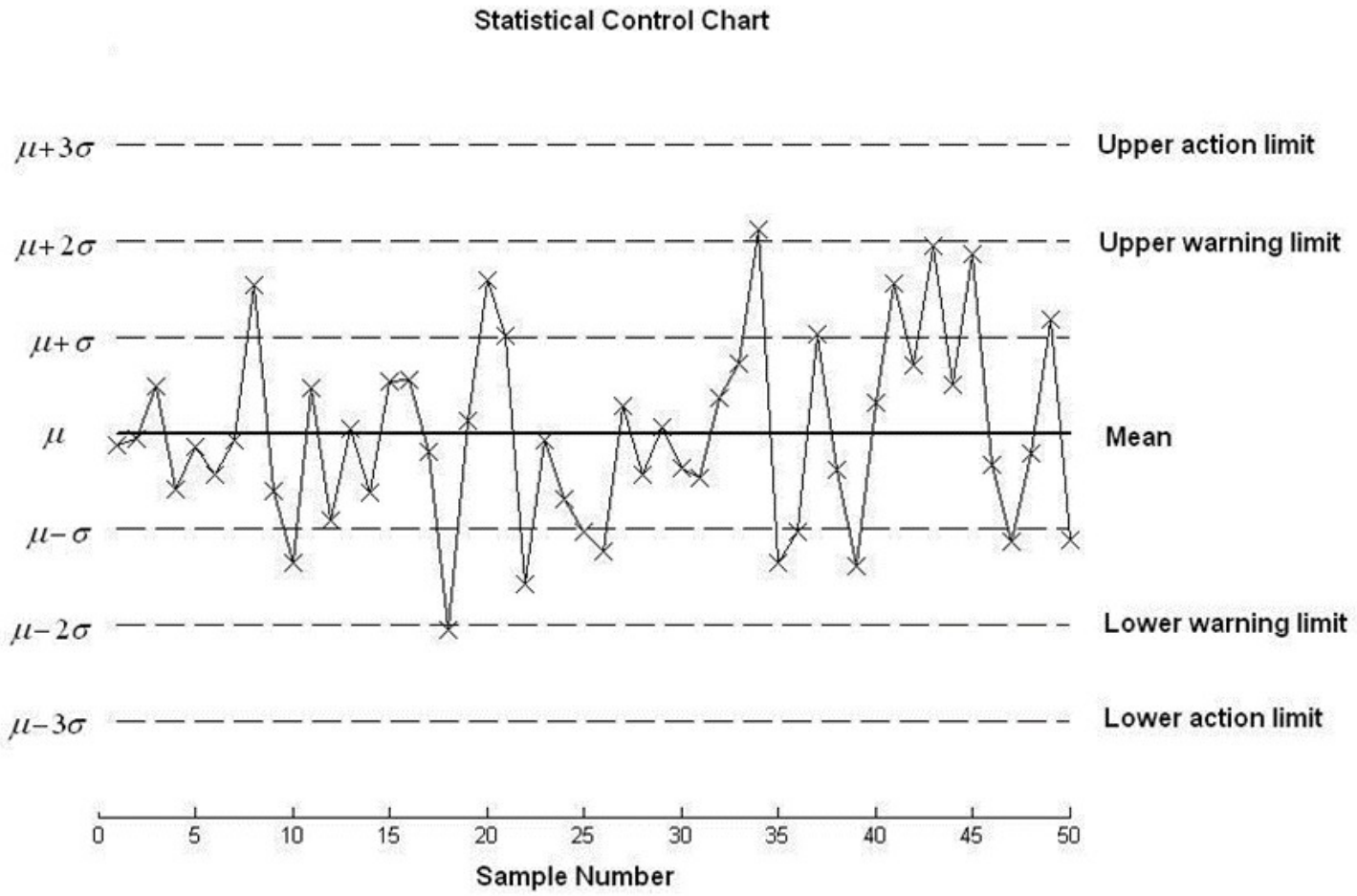
Control Chart



GOVERNMENT OF WESTERN AUSTRALIA

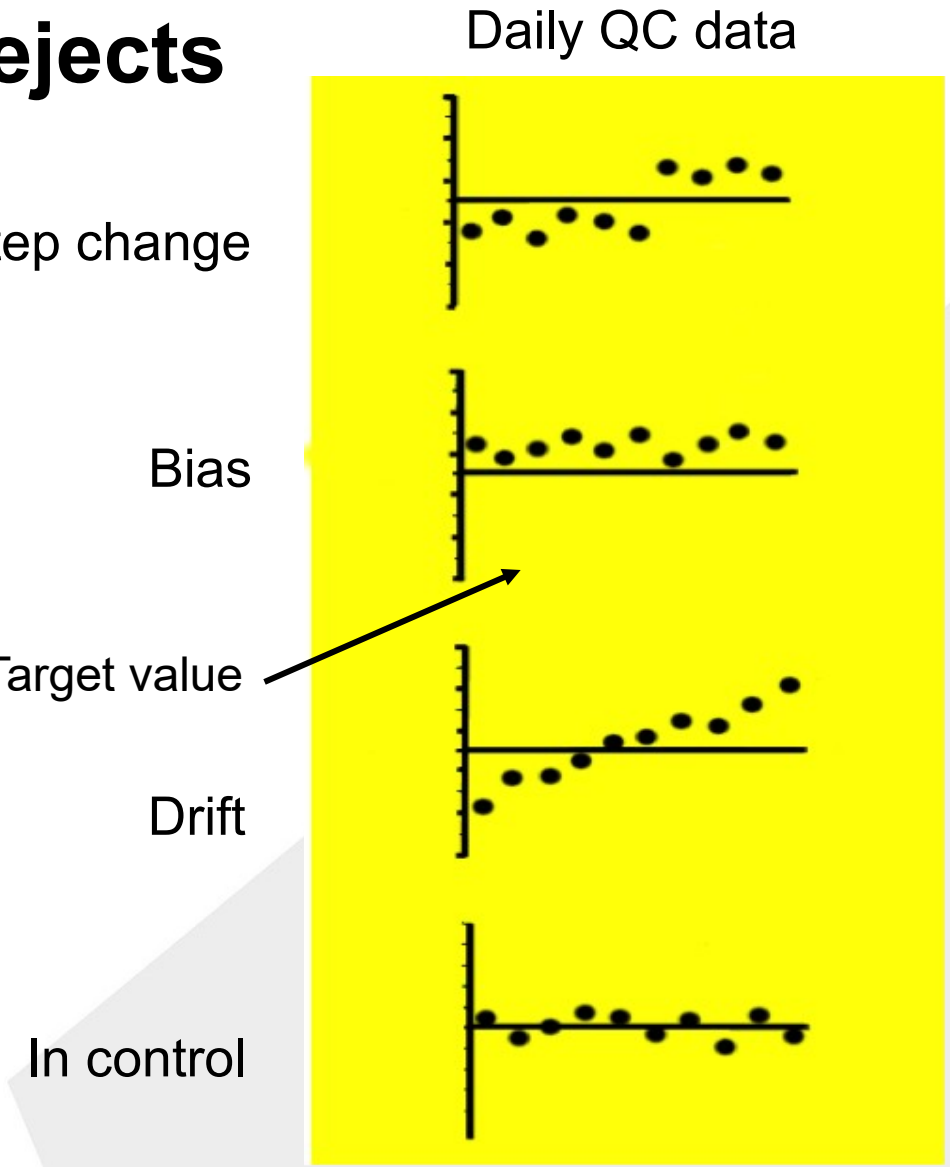
TAFE WA North Metropolitan

Control Chart

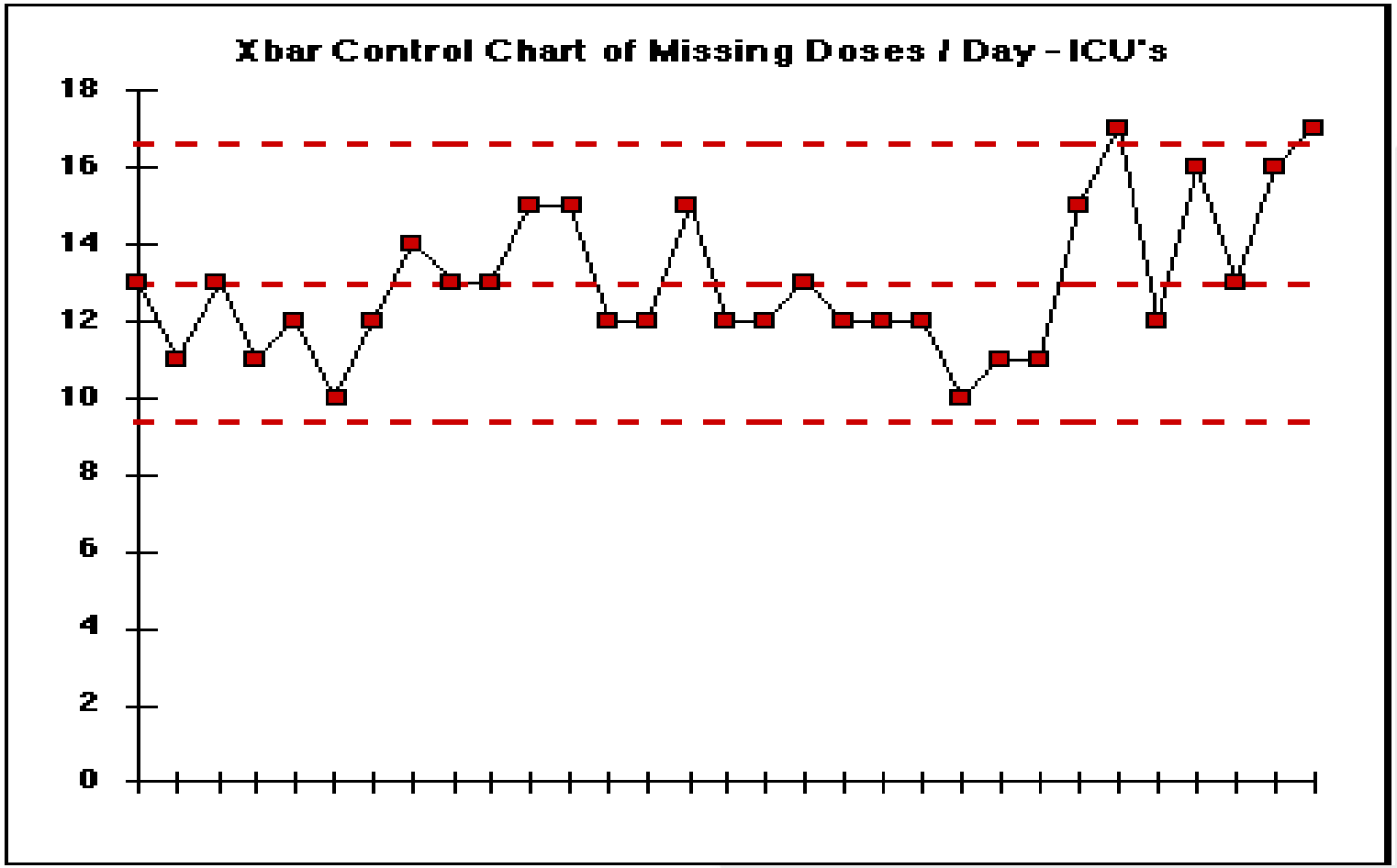


Identifying rejects

Regular analysis of a single control sample will identify a system in or out of control conditions



Record and Evaluate the Control Values



GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

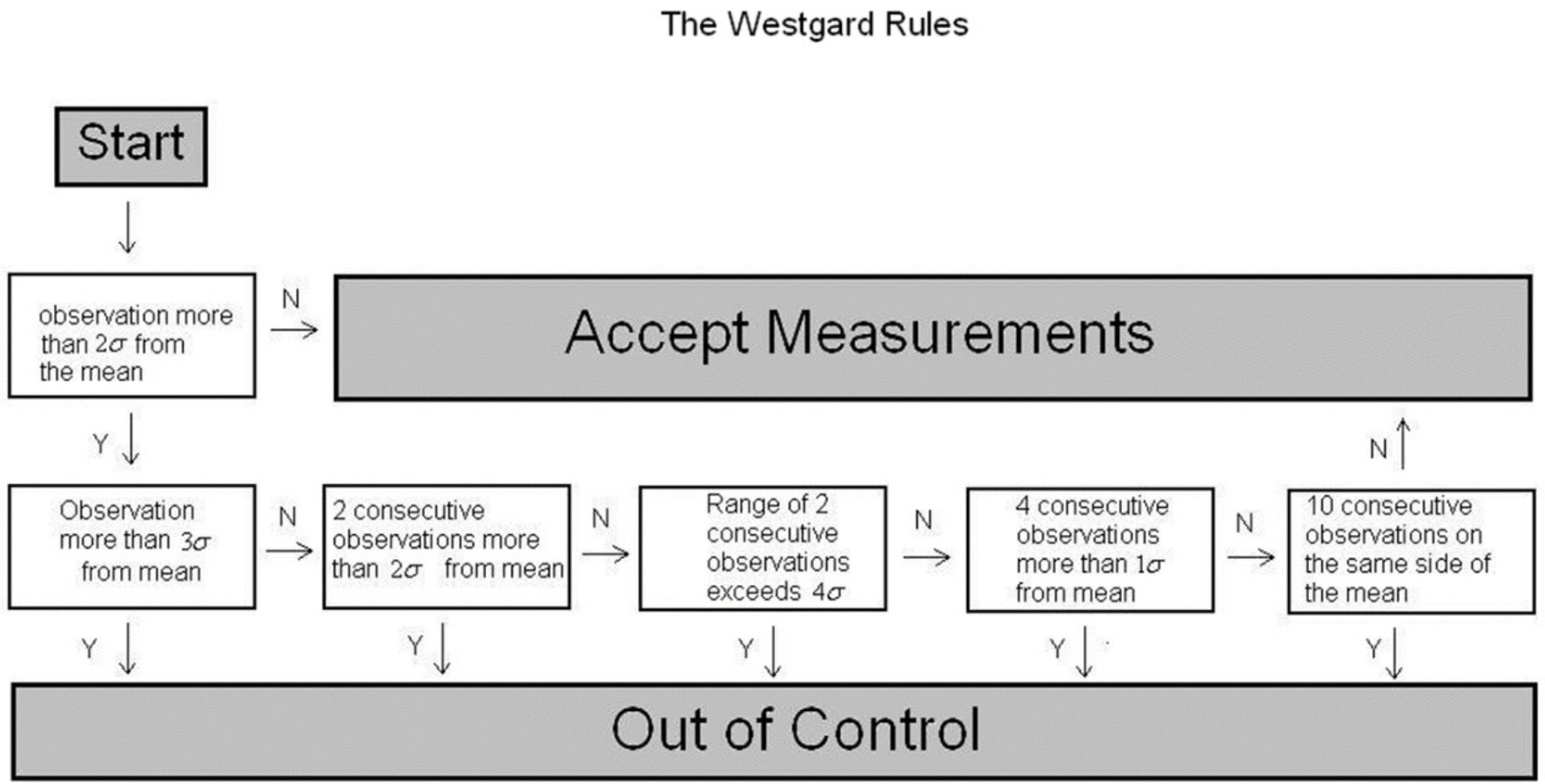
Control Charts

- May be **± 2 or ± 3 standard deviations** depending upon requirements
- When the control values fall within the expected range, you classify the run to be **"in-control,"** accept the results, and report test results.
- When the control values fall outside the expected range, you classify the run as **"out-of-control,"** reject the test values, and do not report test results - report to your supervisor

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Flow Chart



GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

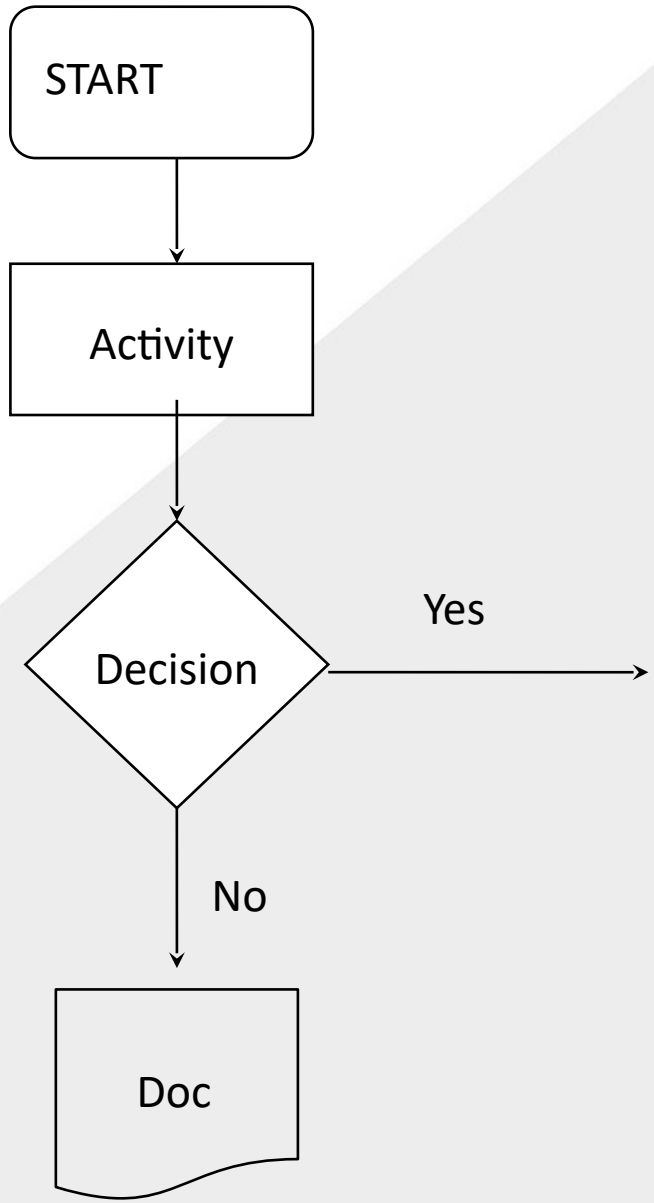
Flow Charts

- Everything that happens in an organization is part of a process.
- Flow charts are a powerful tool for studying processes and identifying opportunities for improvement.

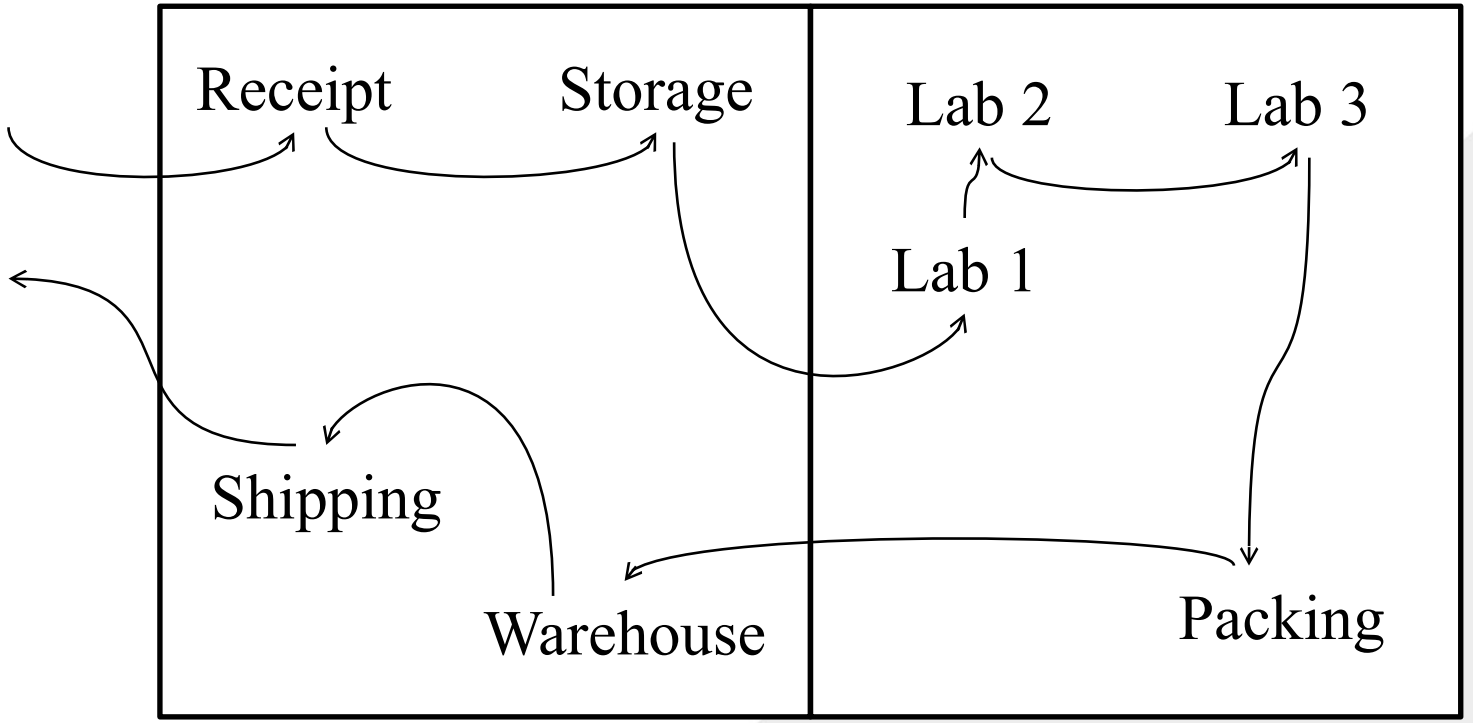
Flowcharts

- A pictorial representation showing all of the steps of a process.
- Define symbols before beginning
- Stay consistent
- Check that
- procedures are followed

Symbol	Name	Function
	Start/end	An oval represents a start or end point
	Arrows	A line is a connector that shows relationships between the representative shapes
	Input/Output	A parallelogram represents input or output
	Process	A rectagle represents a process
	Decision	A diamond indicates a decision



Work Flow Chart

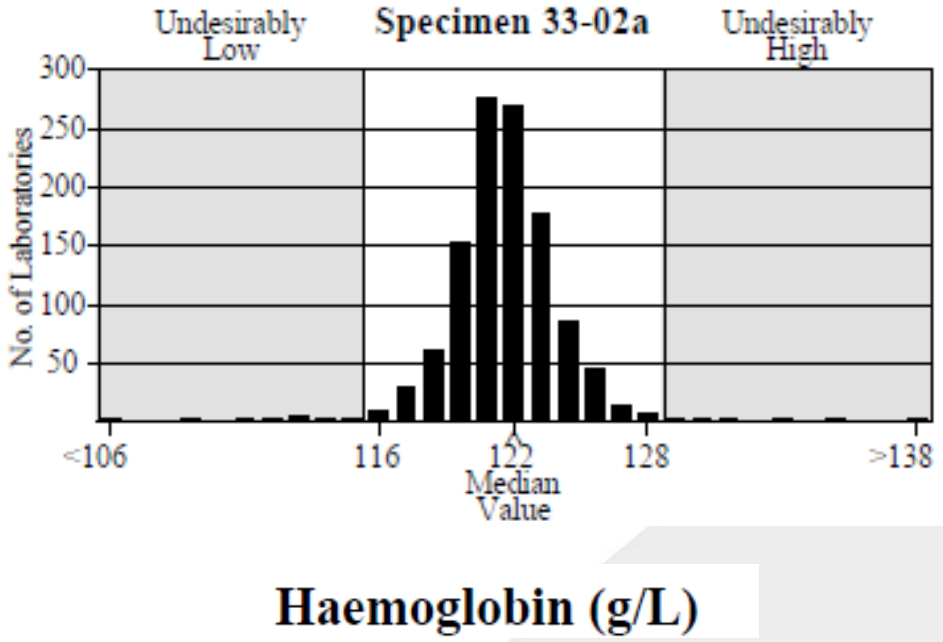


Can follow path of a sample, forklift, document, person etc

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

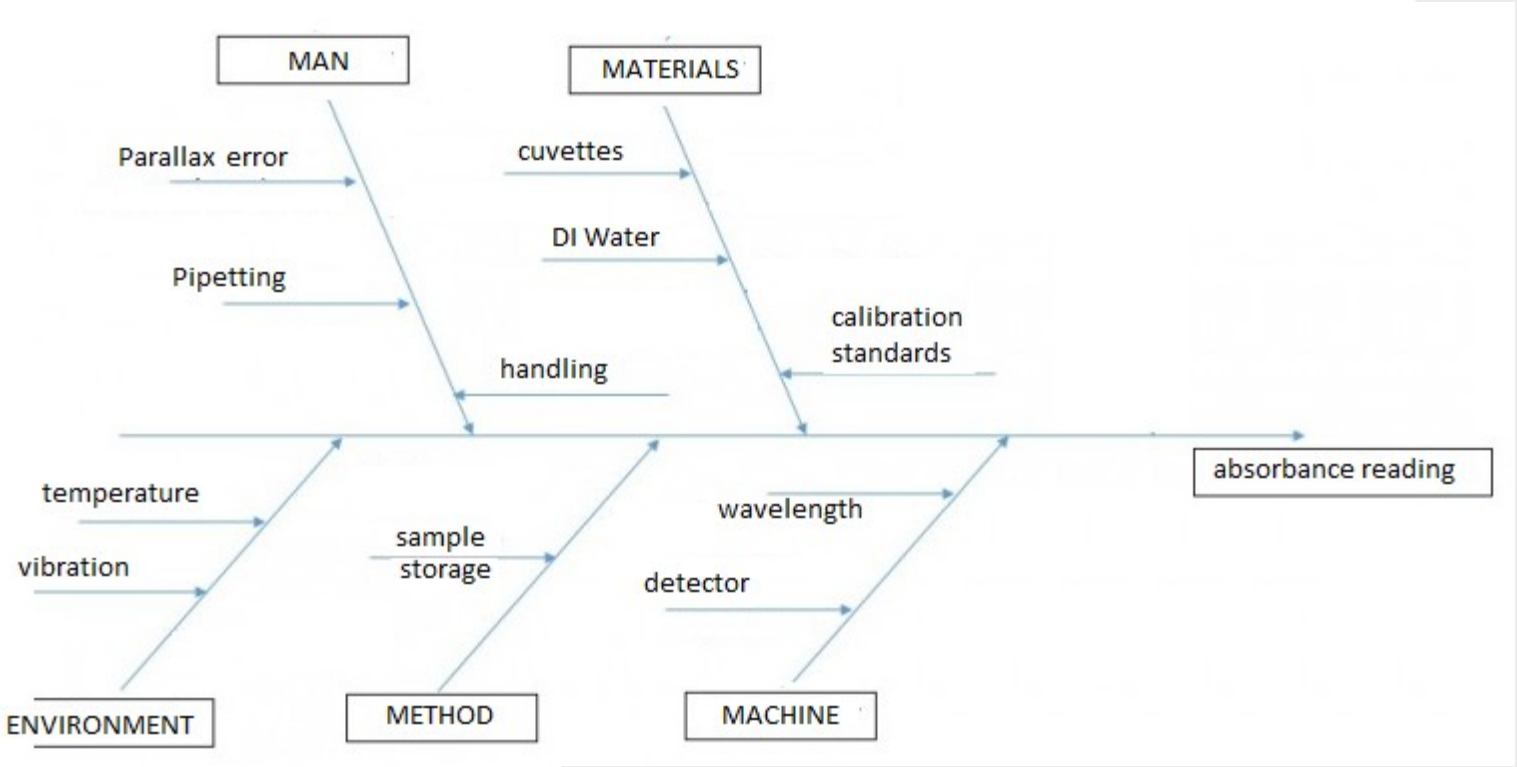
Histogram



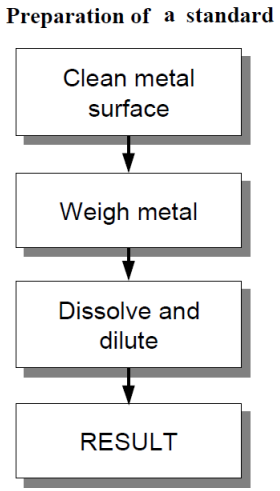
GOVERNMENT OF WESTERN AUSTRALIA

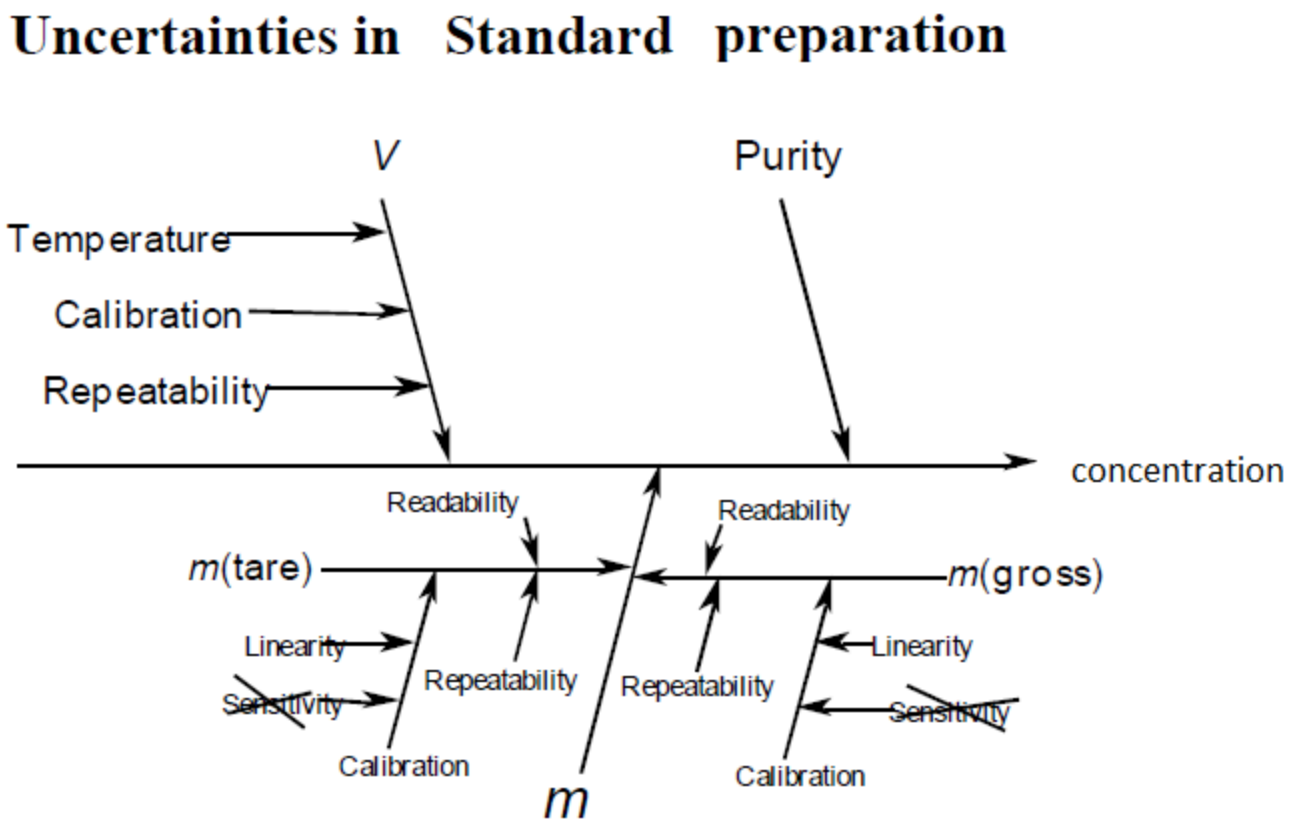
TAFE WA North Metropolitan

Fishbone diagram



Fishbone diagram (and flow chart)

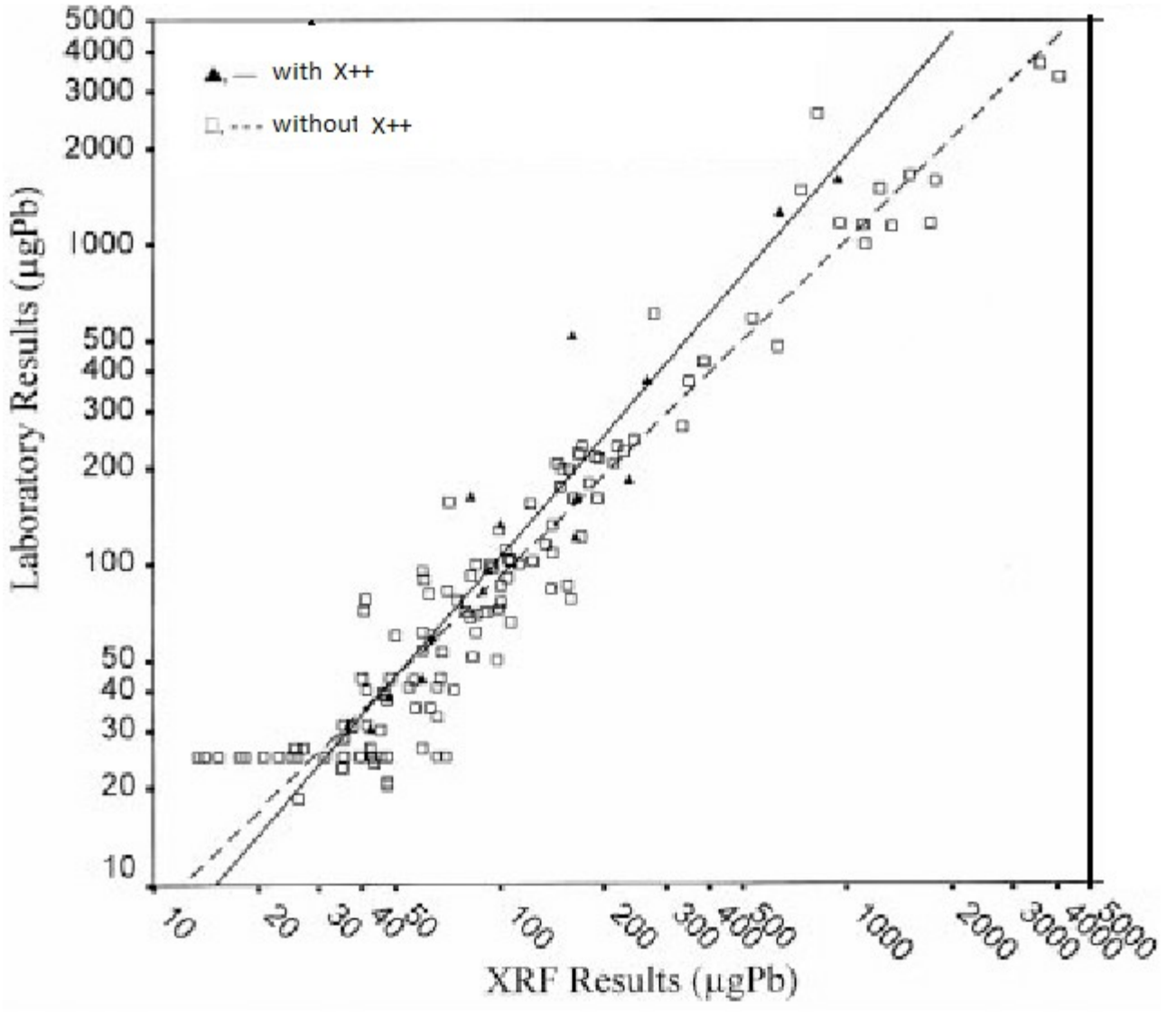




GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

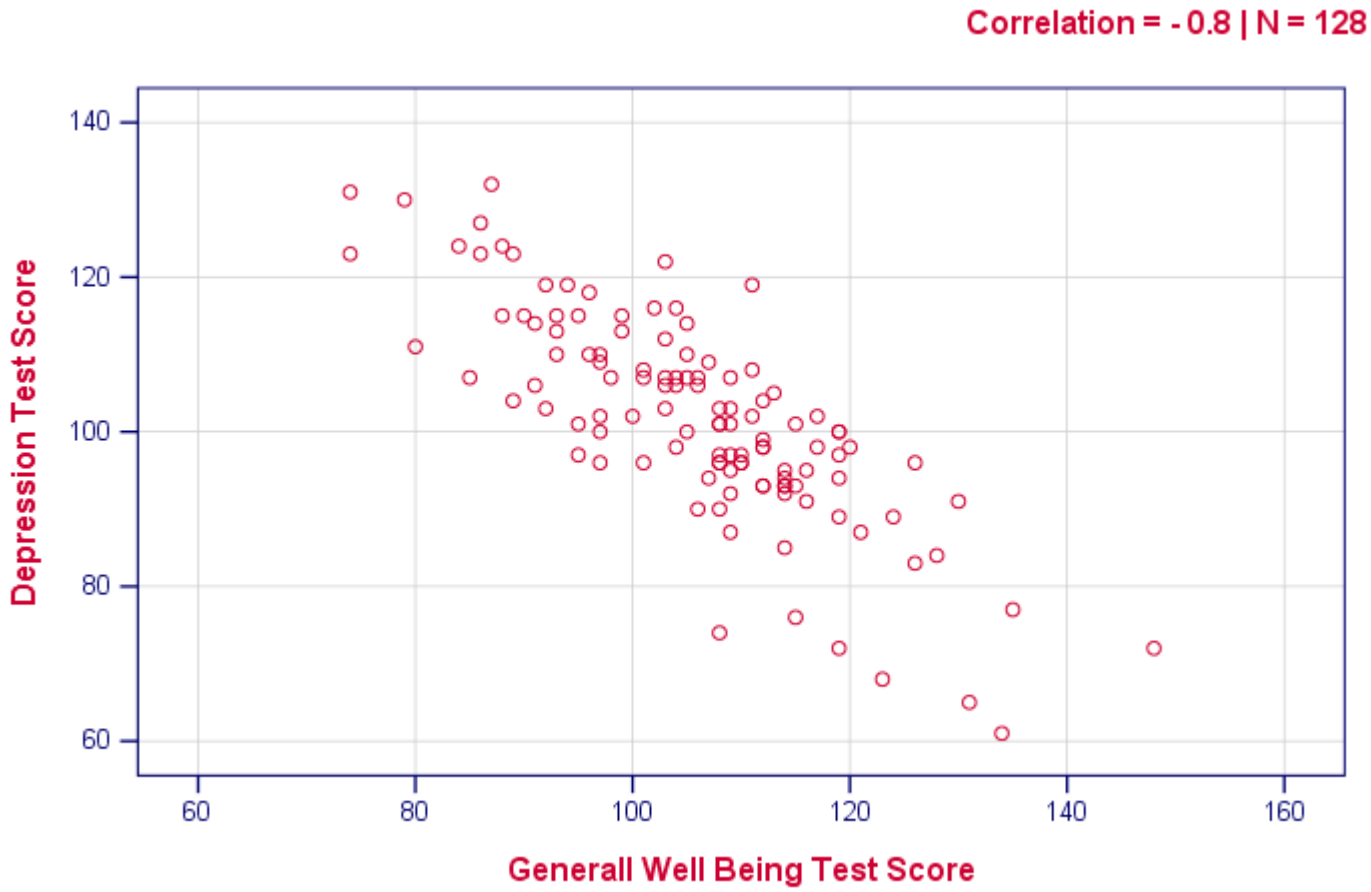
Scatterplot



GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Scatterplot (correlation)



GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Pareto Analysis

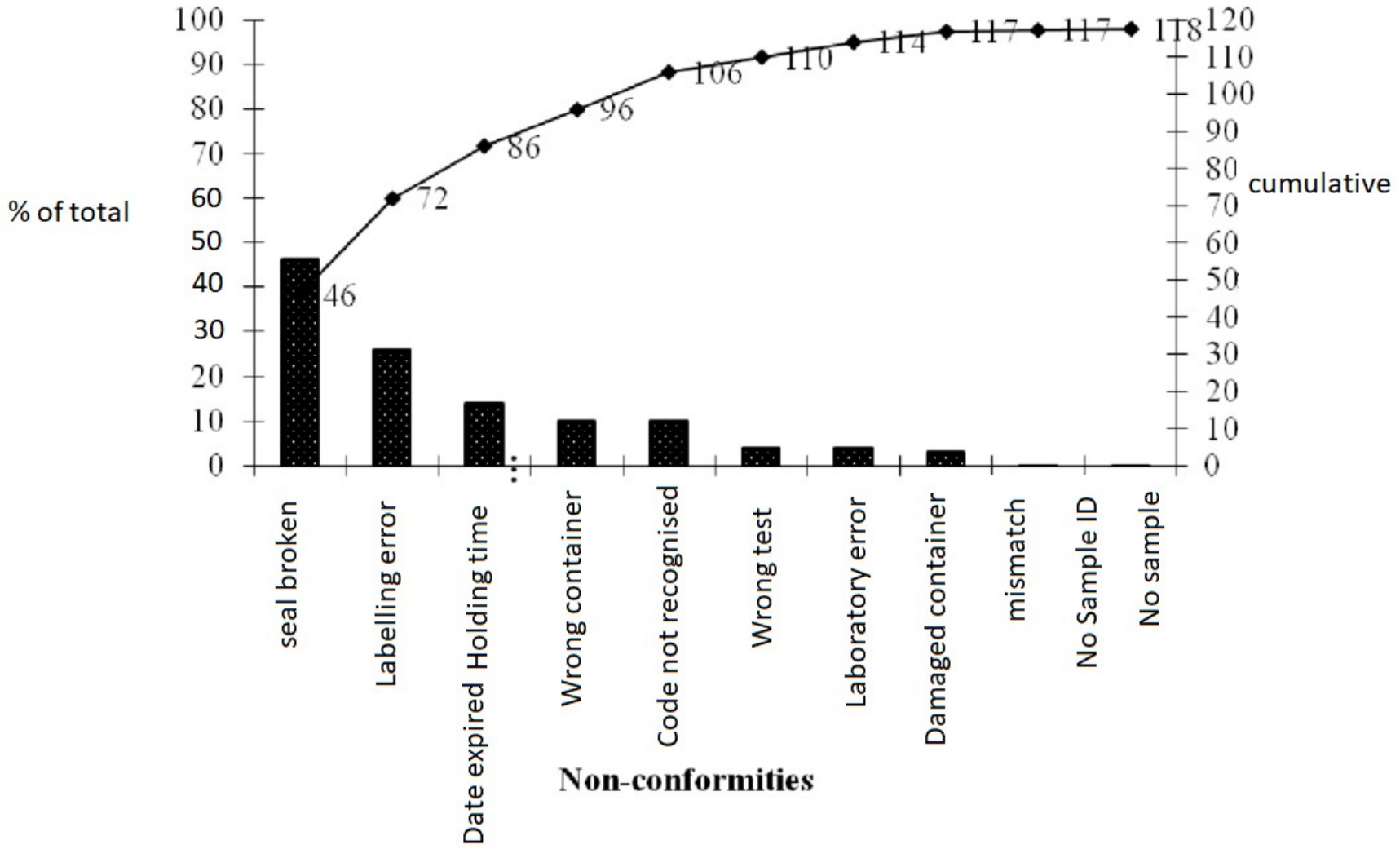
- Pareto charts are used to identify and ranking problems so that the biggest ones are easily identified.

  – *“approximately 20% of the problems account for 80% of the trouble.”*

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Pareto Chart



Proficiency Testing

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

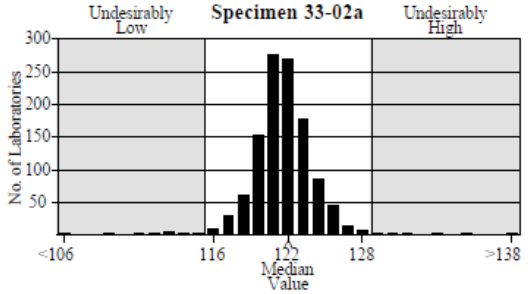
Printed
Feb 27 12:50:09 2019
HAFB003302000050030100SUR01

Prepared by:
RCPAQAP Haematology

Due Date : 25/02/2019

Haemoglobin (g/L)

Participant Number 5003.1



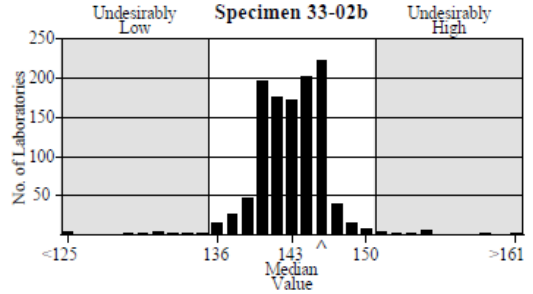
YOUR DATA

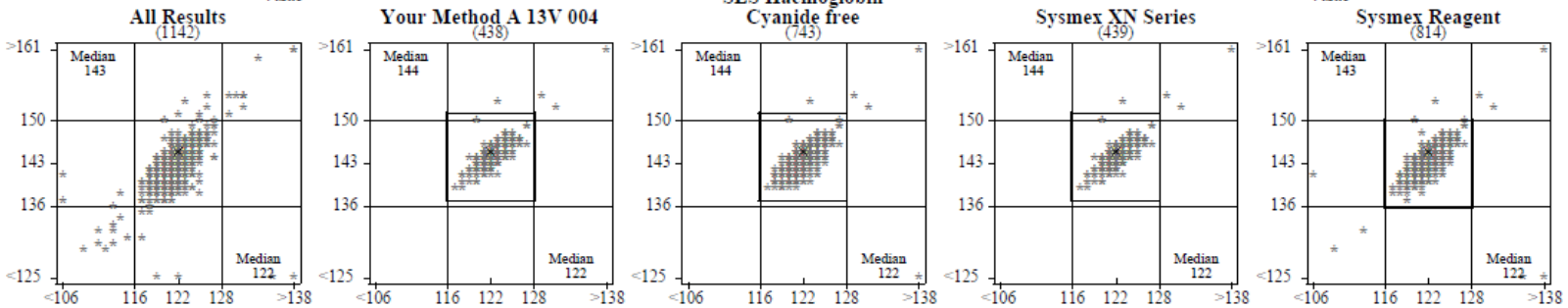
Result (^) for 33-02a = **122** g/L
Result (^) for 33-02b = **145** g/L

Your Method Classification : **A 13V 004 J**

A 13V 004 J
SLS Haemoglobin Cyanide free
Sysmex XN Series
Sysmex
Sy: XN-20 / 2000 **Serial No. 13159**

Analytical Performance Specifications
±5 up to 100; ±5% >100 g/L

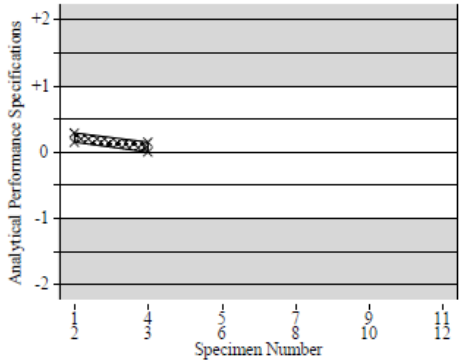


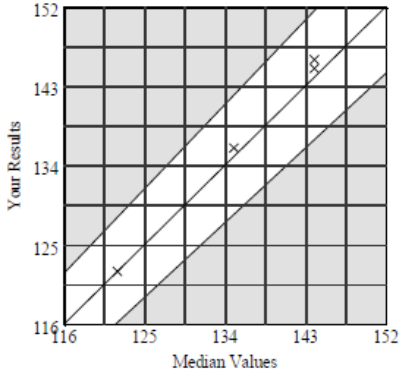


Current Data for Cycle 33

Spec.	Method	Median	Result
> 33-01a	A 13V 004 J	144	146
> 33-01b		135	136
> 33-02a	A 13V 004 J	122	122
> 33-02b		144	145
33-03a			
33-03b			
33-04a			
33-04b			
33-05a			
33-05b			
33-06a			
33-06b			

SUMMARY DATA Using Method Medians with filter: # 13V ### #





Full Blood Count

Equipment Registers and Calibration Schedules

The equipment register is the most important element in managing the quality of equipment.

*Section **6.4** **Equipment** within AS_ISO-IEC 17025 (2018)*

ISO/IEC 17025:2017 Section 6.4: Equipment

- **General Requirements**: Laboratories must have access to equipment required to performance of their activities.
- **Equipment Management**: A procedure for handling, transport, storage, use, and planned maintenance of equipment must be in place to ensure proper function and to prevent contamination or deterioration.
- **Calibration and Verification**: Equipment requiring calibration must be calibrated before being put into service and regularly thereafter, according to a specified schedule.
  - Calibration must be traceable to SI units of measurement or other internationally accepted standards.
  - Laboratories must have procedures to verify that equipment conforms to specified requirements before use.

ISO/IEC 17025:2017 Section 6.4: Equipment

- **Equipment Records**: Complete and updated records of equipment must be maintained.
  - These records should include- Identity of the equipment (e.g., manufacturer, type, serial number).
  - Calibration dates, results, and adjustments.
  - Maintenance plan and maintenance performed.
  - History of damage, malfunction, modifications, or repair.
- **Out-of-Service Equipment**: Equipment that is found to be defective or outside specified limits must be taken out of service.
  - Laboratories must take appropriate measures to ensure that such equipment is not used until it has been repaired and shown to be functioning properly.

NATA Accreditation

- https://www.nata.com.au/accredited-facility

Further reading

- AS 17025
- GLP
- RCPA Quality Assurance Programs – *Proficiency testing results*

Today's Session: Session 11

- Recap-
  - Calibration Curve for Permanganate (Exercise 5, pages 26 to 30) MDL calculation
  - Method comparison and validation (Exercise 6, pages 31 to 33)
- Recording and Reporting requirements as detailed in ISO/IEC17025
- Quantitative analysis of copper (II) (Exercise 7)

Review question- Exercise 5

3.

i. What is the linear range?

ii. Why is it important that the calibration curve be linear?

iii. Calculate the Method Detection Limit (MDL).

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Recap- Method comparison and validation

Review questions

1. In reviewing % Accuracy error results and applying the criteria of ±0.5%, which alternative cuvette would be acceptable?

2. What reasons would lead an organisation to perform this type of method validation?

3. What efficiencies could be gained from the changes?

4. Refer to exercise 1, identify an appropriate quality tool and complete.

Recording, reporting and document control requirements.

ISO/IEC 17025

Figure B.1 illustrates an example of a possible schematic representation of the operational processes of a laboratory, as described in Clause 7.

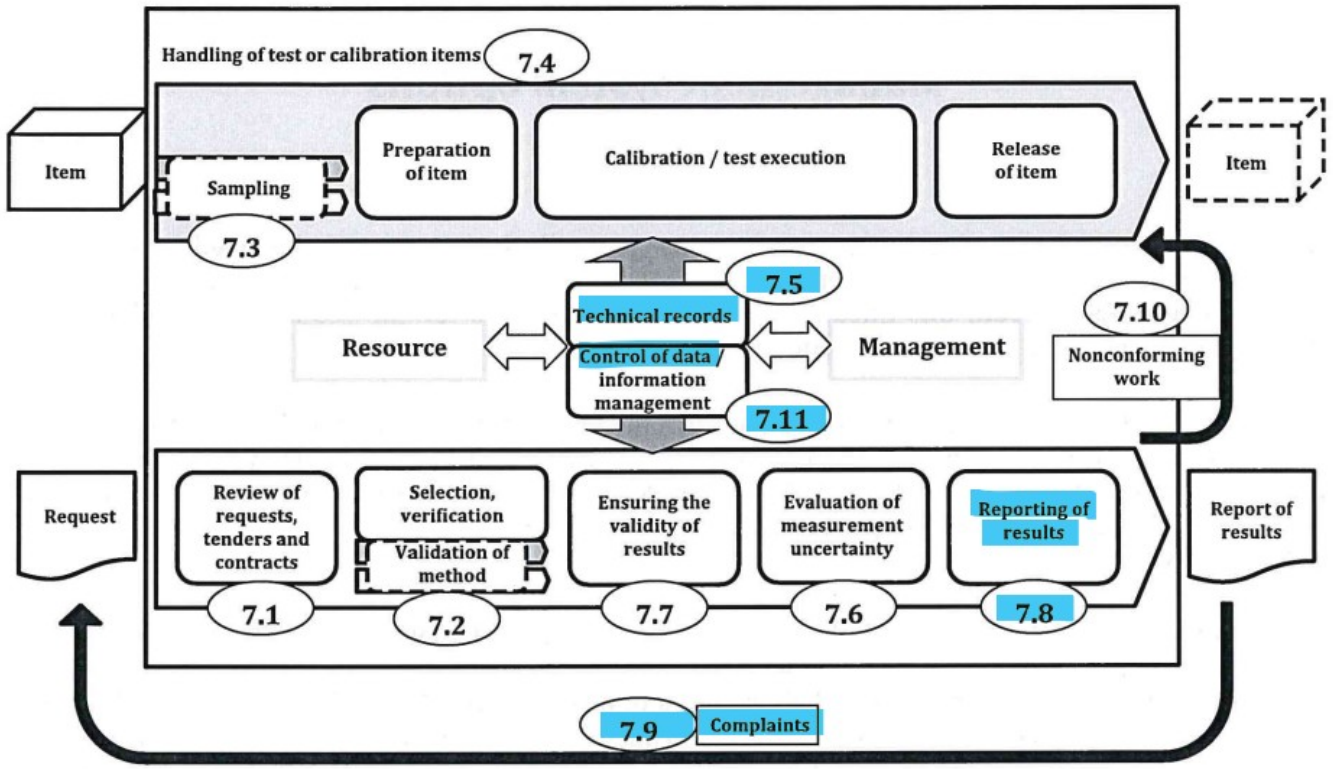


Figure B.1 — Possible schematic representation of the operational processes of a laboratory

Data recording requirements

Recording requirements as detailed in section 7.5 of ISO/IEC 17025

Data Collection: Establish protocols for collecting quality control data during each stage of the testing process.

- This includes data related to
  - calibration, equipment maintenance, sample preparation, analysis, and instrument performance.

Data Recording: Trained Laboratory technicians responsible for recording technical data accurately.

- Data should be recorded in a standardised format that includes all relevant information such as
  - Identity of personnel, sample identification, test parameters, instrument readings, calculations, Quality control data and any deviations.

Client Reporting requirements

Reporting requirements as detailed in section 7.8 of ISO/IEC 17025

- ***Verify results-*** Validation of data, a second technician checks results for any errors/consistencies.
- ***Prepare the Report-*** Standard template report (section 7.8.2).

Information may include,

- Test method, test parameters (e.g. any preparation techniques, any reference standards, LOR, measurement uncertainty MU)
- Individual Sample Identification
- Date of analysis
- Results recorded, to specific significant figures and units
- Date of report issue
- Identification of authorized personnel to finalise report

Client Reporting requirements

- ***Review results finalised-*** before sending report to client review the results a final time to ensure accuracy and completeness.
- ***Report to the client-*** Once results have been verified and reviewed, issue report to client. (For example, by email, PDF, paper reports or online portals)
- ***Ensure confidentiality-*** Maintain the confidentiality of the client results, at all times. Use secure methods and ensure only authorised personnel have access to the results.
  - This includes notifying appropriate staff of any significant deviations or issues that may impact the validity of test results.
- ***Document the communication:*** Keep a record of when and how results were reported to the client. Important for traceability and Quality control purposes.

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Analytical Report Examples

QUICKSILVER SCIENTIFIC

Elemental Analysis - Whole Blood
by Inductively Coupled Plasma/Mass Spectrometry
[redacted]
Lab Director: Christopher W. Shade, PhD

Jane Doe

Practitioner: John Doe
Date Of Birth: 2/6/1971

Dates	Taken	Arrived	Analyzed
Present	7/21/2021	8/2/2021	8/10/2021
Previous	12/7/2017	12/12/2017	1/3/2018

Nutrient Elements

Element	Results	Prior	Recommended Limit	Units	Percentile Rank by Quintile (10 20 30 40 50 60 70 80 90)	Percentile
Calcium (Ca)	5.25	5.38	4.7 - 6.4	mg/dL		27%
Copper (Cu)	87	80	63 - 113	µg/dL		47%
Lithium (Li)	0.8	179.4	< 0.1 - 21	µg/L		42%
Magnesium (Mg)	3.35	3.30	2.93 - 4.17	mg/dL		30%
Manganese (Mn)	7.3	6.3	4.26 - 14.3	µg/L		26%
Molybdenum (Mo)	2.2	0.3 B	< 0.2 - 1.9	µg/L		99%
Selenium (Se)	196	155	79 - 362	µg/L		39%
Zinc (Zn)	583	564	454 - 745	µg/dL		43%

Whole Blood Element Ratios

Element	Results	Prior	Recommended Limit	Units	Percentile Rank by Quintile (10 20 30 40 50 60 70 80 90)	Percentile
Ca/Mg Ratio	1.57	1.630	1.20-1.99	NA		46%
Cu/Zn Ratio	0.149	0.14	0.09-0.21	NA		48%

Toxic Elements

Element	Results	Prior	Recommended Limit	Units	Percentile Rank by Quintile (10 20 30 40 50 60 70 80 90)	Percentile
Antimony (Sb)	3.9	NA	< 7.0	µg/L		32%
Arsenic (As)	1.2	0.3 B	< 6.3	µg/L		37%
Cadmium (Cd)	0.2 B	0.2 B	< 0.74	µg/L		33%
Lead (Pb)	1.02	1.31	< 2.34	µg/dL		41%
Mercury (Hg)	1 B	0.9 B	< 5.8	µg/L		33%

Potentially Toxic Elements

Element	Results	Prior	Recommended Limit	Units	Percentile Rank by Quintile (10 20 30 40 50 60 70 80 90)	Percentile
Cobalt (Co)	0.3 B	0.2 B	< 2.0	µg/L		50%
Silver (Ag)	0.2 B	< 0.1	< 2.6	µg/L		49%
Strontium (Sr)	23	23	< 470	µg/L		48%

These test results are not intended for the diagnosis of disease. They are intended for interpretation by qualified healthcare professionals with a full knowledge of patient history to assist in their administration of an appropriate healthcare regimen.

1960 Cherry Street [redacted]

Comprehensive Neurotransmitter; urine

DOCTOR'S DATA, INC.

Order: U000000-0000-0
DOCTOR:
Client #: 1234
Doctor's Data, Inc.
3755 Illinois Ave.
St. Charles, IL 60174 U.S.A.

Patient: Sample Report
Id: Sample-I-02219
Age: 56 **DOB:** 07/17/1963
Sex: Female
Body Mass Index (BMI): N/A

Sample Collection	Date/Time
Date Collected	11/31/2019
Wake Up Time	06:00
Collection Period	2nd morning void
Date Received	12/06/2019
Date Reported	12/16/2019

Analyte	Result	Unit per Creatinine	L	WRI	H	Reference Interval
Phenethylamine (PEA)	101	nmol/g				42 – 160
Tyrosine	197	µmol/g				70 – 180
Tyramine	5.4	µmol/g				2.8 – 8.5
Dopamine	272	µg/g				175 – 500
3,4-Dihydroxyphenylacetic acid (DOPAC)	898	µg/g				540 – 1850
3-Methoxytyramine (3-MT)	288	nmol/g				122 – 278
Norepinephrine	45.5	µg/g				29 – 69
Normetanephrine	176	µg/g				112 – 400
Epinephrine	8.2	µg/g				2.1 – 14.5
Metanephrine	102	µg/g				60 – 158
Norepinephrine / Epinephrine ratio	5.6					< 13
Tryptamine	0.35	µmol/g				0.65 – 1.6
Serotonin	29.8	µg/g				79 – 235
5-Hydroxyindoleacetic acid (5-HIAA)	1583	µg/g				2500 – 9000
Glutamate	22	µmol/g				18.0 – 70.0
Gamma-aminobutyrate (GABA)	6.3	µmol/g				2.6 – 8.0
Glycine	3636	µmol/g				700 – 2500
Histamine	41	µg/g				14 – 51
Taurine	1448	µmol/g				420 – 1400
Creatinine	13.4	mg/dL				25 – 180

Neurotransmitter Comments:

- Urinary neurotransmitter levels provide an overall assessment of the body's ability to make and break down neurotransmitters and are representative of whole body levels. Neurotransmitters are secreted all through the body, in neurons of both the central and peripheral nervous systems. The enzymes, cofactors and precursors in neurotransmitter metabolism in general are the same in the periphery and in the central nervous system. Therefore, alterations in urinary neurotransmitter levels assessed in urine provide important clinical information, and may be associated with many symptoms including cognitive and mood concerns, diminished drive, fatigue and sleep difficulties, cravings, addictions and pain.
- Tyrosine is the non-essential amino acid precursor for dopamine, norepinephrine and epinephrine. Increased tyrosine may exacerbate migraine headaches and hyperthyroid conditions. Elevated tyrosine levels may occur due to supplementation (phenylalanine or tyrosine), heritable enzyme defects, or liver disease. Tyrosine hydroxylase converts tyrosine into the dopamine precursor L-DOPA; BH4, Vitamin D and iron are cofactors for that enzymatic activity.

Notes:
Results are creatinine corrected to account for urine dilution variations. Creatinine is not meant to be used as an indicator of renal function.
Ref= Reference Interval, L (blue)= Low (below RI), WRI (green)= Within RI (optimal), WRI (yellow)= Within RI (not optimal), H (red)= High (above RI)
Methodology: LC/MS QQQ Creatinine by Jaffe Reaction

Analyzed by DOCTOR'S DATA, INC. • 3755 Illinois Avenue, St. Charles, IL 60174-2420 USA • LAB DIR: Eric Roth, MD • CLIA ID: 14D0646470

TÜVRheinland®
Precisely Right.

CERTIFICATE

Of Conformity of Pneumatic Proof Test
FOR STAINLESS STEEL GAUGE COCK

ORDER NO. : **166225433**

CERTIFICATE NO. : **166225433-005**

NAME OF MANUFACTURER : M/s. DAWSONS-TECH COMPONENTS LLP
Unit No. DD - 6 & 7, Khan Real Industrial Estate,
N. H. 08, Pelhar, Vasai Phata, Vasai (East),
Dist. Palghar - 401208, Maharashtra, INDIA.

Testing Parameters :

1. Test Medium : Nitrogen Gas
2. Pressure Rating / Test Pressure : 25 Bar (368 PSIG) / 30 Bar (435 PSIG)
3. Test Pressure variations : ± 5 % Bar (PSIG)
4. Pressure Gauge : Calibration Certificate reviewed
5. Temperature During Test : 20^{O} C to 40^{O} C
6. Material of Construction : SS316
7. Verification of material properties : Material test certificate reviewed
8. Verification of Dimensions : Verified inspection report with relevant drawing of each components
9. Time for monitoring leakage : 3 minutes
10. Quantity of each size of Gauge Cock : 3 Nos

Procedure of Pneumatic Proof Test :
As per DAWSONS-TECH Pneumatic Proof Test procedure Reference No. DT-PNT-VALVE-00.

Test Result :
The test result shown below for the Pneumatic Proof Test is carried out as per above procedure.

End Connection		Tested Valve No.	Recorded Tested Pressure Bar (PSIG)	Result
Type	Size			
Male to Female BSP	1/4"	VGC01-MF4G/SS-1	32 (464)	PASS*
		VGC01-MF4G/SS-2	35 (507)	PASS*
		VGC01-MF4G/SS-3	30 (435)	PASS*
Male to Female BSP	1/2"	VGC01-MF8G/SS-1	35 (507)	PASS*
		VGC01-MF8G/SS-2	32 (464)	PASS*
		VGC01-MF8G/SS-3	33 (478)	PASS*

PASS* : No leakage detected during the test.

Comments : DAWSONS-TECH Stainless Steel Gauge Cock Series : VGC01 meets the requirements of Pneumatic Proof Test.

For, **TUV Rheinland (India) Pvt. Ltd.**

Malcolm Dadina
(General Manager - Industrial Services)

Date : 28/01/2020

TUV Rheinland (India) Pvt. Ltd. D.S Business Galleria Office no – 1209 12th Floor, L.B.S Marg Kanjurmarg (W) Mumbai, Maharashtra 400 078, India Telefon:-+91 80 46498214

Client Reporting requirements

- ***Address any Client inquiries-*** Be prepared to address any questions or concerns that the client may have regarding the results. (Section 7.9 Complaints in ISO/IEC 17025)

- ***Feedback and Improvement:*** Collect client feedback regarding the report process and results (Positive & Negative).
  - Use feedback to continuously improve the reporting procedure and customer satisfaction.

Activities

- Assessment Task 3 (pages 18-19)
  - *Calculate Control chart Limits*

- Quantitative analysis of copper (II)
  (Exercise 7, pages 34 to 37)

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Session 4 Introduction

MSL934008 Maintain instruments and equipment

MSL934009 Apply Quality Systems and Continuous Improvement Processes

Session 3 review

Analytical Balances

- ❑ Work Instruction-WI002 Using an Analytical Balance
- ❑ Calibration checks, single point and repeatability

(Assessment Task 1a Practical observations).

Equipment verification, Equipment registers and calibration schedules

In class activity: Develop a 'Maintenance and Calibration Schedule' for the following equipment in your laboratory.

Today's Outcome

Introduction to Auto-pipette (POVA)

- Work instruction,
- Safety, faults, inspect and clean POVA
- Calibration ISO 8655-6 (2022) and
- Calibration and calibration volume check requirements.

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Analytical Balances

BALANCE SIX (6) MONTHLY REPEATABILITY CHECK

NMTAFE Balance ID	
Make	
Model	
Serial No.	
Current Location	
Calibration Due Date	
Certified Calibration Mass (M)	
Repeatability of Measurement (sr)	

NOTE: Do not re-zero the balance in between any readings

No.	Pan Load	Scale Reading (g)	Difference r= (M-m+z)	
1	None Standard Mass	z1 = m1 =	r1 =	0.0000 g
2	None Standard Mass	z2 = m2 =	r2 =	0.0000 g
3	None Standard Mass	z3 = m3 =	r3 =	0.0000 g
4	None Standard Mass	z4 = m4 =	r4 =	0.0000 g
5	None Standard Mass	z5 = m5 =	r5 =	0.0000 g
6	None Standard Mass	z6 = m6 =	r6 =	0.0000 g
7	None Standard Mass	z7 = m7 =	r7 =	0.0000 g
8	None Standard Mass	z8 = m8 =	r8 =	0.0000 g
9	None Standard Mass	z9 = m9 =	r9 =	0.0000 g
10	None Standard Mass	z10= m10=	r10 =	0.0000 g

Standard Deviation (n-1): δ = 0.0000 g

2x sr = 0.0000 g FAIL

NOTE: If Standard Deviation is greater than 2x sr value obtained at last calibration, then balance may need recalibration and/or servicing.

Checked by: _____ Date: _____

Reference: NATA General Accreditation Guidance User Checks and Maintenance of Laboratory Balances Jan 2018; Morris, E. & Fes, K., "The Calibration of Weights and Balances", Australian Government National Measurement Institute CSIRO (2003); Page 48, Section 6.3.2 & Page 53, Section 6.4.2.

MONTHLY SINGLE POINT CHECK FOR BALANCES

NMTAFE Balance ID	
Make	
Model	
Serial No.	
Current Location	
Calibration Due Date	
Certified Calibration Mass (M)	
Repeatability of Measurement (sr)	

3 YEARLY MASS CALIBRATION DATA				
Mass NATA ID		Calibrated on		
Certified Calibration Mass	M (g)			
Uncertainty of user Mass	Um		Um^2	0.0000 g

NOTE: Do not re-zero the balance in between any readings

READINGS				
	Pan Load	Scale Reading (g)	*After Recalibration (if necessary)*	
1st Zero Reading	z1			
1st Reading of Standard Mass	m1			
2nd Reading of Standard Mass	m2			
2nd Zero Reading	z2			

CORRECTION			
	Calculated	*After Recalibration (if necessary)*	
C1 = (M-(m1-z1))	0.0000 g	0.0000 g	0.0000 g
C2 = (M-(m2-z2))	0.0000 g	0.0000 g	0.0000 g
C3 = (C1+C2)/2	0.0000 g	0.0000 g	0.0000 g
C4 = Correction as reported on the last 3 yearly external Calibration report	0.0000 g	0.0000 g	0.0000 g

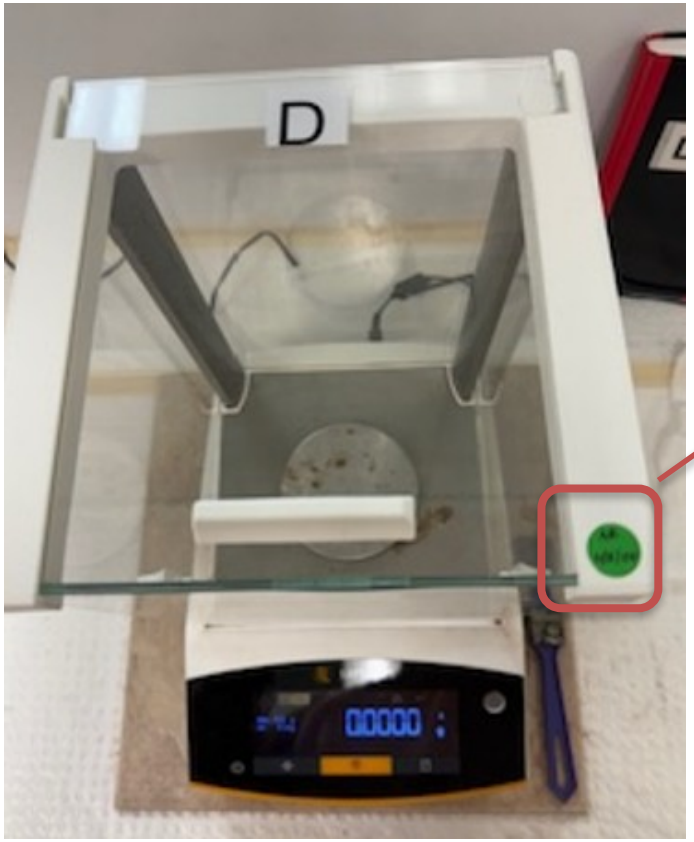
OFFICIAL

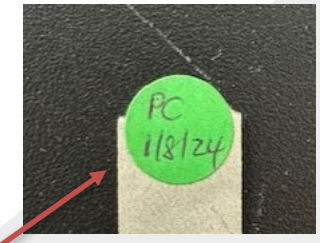
Government of Western Australia
North Metropolitan TAFE

Work Instruction Procedure Summary

Section 1 – Item Description	
Principle of Operation	
Diagram with key components	
Function of Key	

Analytical Balances





Passed QC checks

Equipment and Calibration

PR-EP-NMTLAB-0104

OFFICIAL

Government of Western Australia
North Metropolitan TAFE

Equipment and Calibration

1. **INTRODUCTION**
   This document outlines the procedure for managing laboratory equipment at NMTAFE Laboratory to ensure compliance with ISO/IEC 17025. It includes processes for equipment identification, calibration, maintenance, and record-keeping to maintain the accuracy and reliability of testing and calibration results.

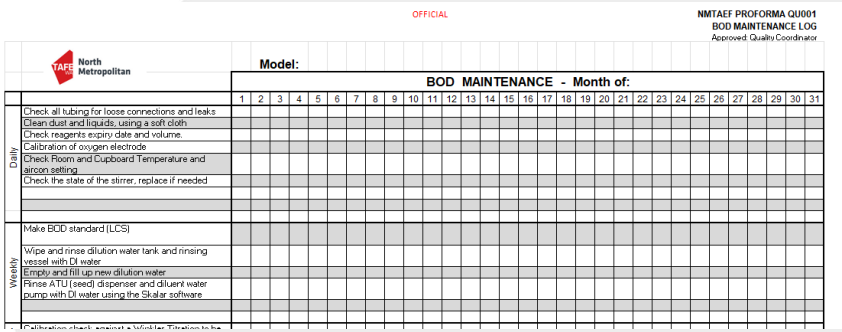
2. **SCOPE**
   This procedure applies to all equipment used for testing and calibration within NMTAFE Laboratory. It covers the complete lifespan of equipment, including selection, procurement, installation, calibration, maintenance, use, and decommissioning.

3. **DEFINITIONS**
   - **Equipment:** Any device or apparatus used in the testing or calibration processes.

Documentation and Systems

Companies many interconnected systems to sort, maintain, and identify their equipment

- Equipment Register
- Calibration and Maintenance Schedule
- Maintenance logs
- List of Manufactures and contact details
- List of Authorised external contractors, Service operators and their contact details



OFFICIAL

NMTAEF PROFORMA QU001
BOD MAINTENANCE LOG
Approved: Quality Coordinator

North Metropolitan

Model:

BOD MAINTENANCE - Month of:

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Daily	Check all tubing for loose connections and leaks																															
	Clean dust and liquids, using a soft cloth																															
	Check reagents expiry date and volume.																															
	Calibration of oxygen electrode																															
	Check Room and Cupboard Temperature and aircon setting																															
	Check the state of the stirrer, replace if needed																															
Weekly	Make BOD standard (LCS)																															
	Wipe and rinse dilution water tank and rinsing vessel with DI water																															
	Empty and fill up new dilution water																															
	Rinse ATU (seed) dispenser and diluent water pump with DI water using the Skalar software																															

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Equipment Registers

NMTAFE LABORATORY EQUIPMENT REGISTER

NMTAFE ID	Description	Make/ Manufacturer	Model	Serial Number	Date of Purchase	Location in Lab	Status (In Use / Out of Service)	

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Care and Maintenance of Lab Equipment

General care and maintenance of laboratory equipment

- General care can include cleaning, servicing, maintenance, calibrations/calibration checks conducted by trained personnel.

Advantages of having an Equipment assurance program in your laboratory

- Equipment is costly and doing maintenance can extend the life of equipment before replacing.
  - Reduces downtime of equipment failure.
  - Increase productivity.
- To determine when equipment may need maintenance
  - Check for any drifts/variations/discrepancies.
  - Traceability.
- Accuracy and Precision
- Data integrity
- Ensures that calibrations on equipment are done to a competent standard.
- Accreditation compliance

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Assessment 1d- Care and Maintenance of Lab Equipment

DEVELOP a ***'Maintenance and Calibration Schedule***'

For the following equipment in your laboratory:

1. Analytical Balance
2. Variable Pipette
3. pH meter
4. Drying oven
5. Timers
6. Volumetric glassware and
7. Spectrophotometer

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Session 6

MSL934008 Maintain instruments and equipment
MSL934009 Apply Quality Systems and Continuous Improvement Processes

Session 5 review

- **ASSESSMENT TASK 1b**: Piston Operated Volumetric Apparatus (POVA)
  - Calibration volume checks
  - Practical observations
  - Autopipette procedure summary
  - Video: Pipette Check, According to DIN EN ISO8655, on the Cubis® II Lab Balance
- **ASSESSMENT TASK 1d**: 'Maintenance and Calibration Schedule'

Today's Outcome

- Common sources of faults and their repair
- Arrange any reordering of consumable stocks and equipment components

Activities:

- **ASSESSMENT TASK 1b: (POVA)** Practical observation, for POVA volume checks continue.
  - *Task "Replace/repair" and cleaning steps to be completed*
- **ASSESSMENT TASK 1c:** Communication-Approved suppliers and service technicians,
  - Part A and Part B.
- **ASSESSMENT TASK 1e:** Volumetric Glassware
  - ISO 4787, AS 2162.1-1996

Discussion- Care and Maintenance of Lab Equipment
(LEGAL, ETHICAL AND SAFETY)

General care and maintenance of laboratory equipment

- General care can include cleaning, servicing, maintenance, calibrations/calibration checks conducted by trained personnel.

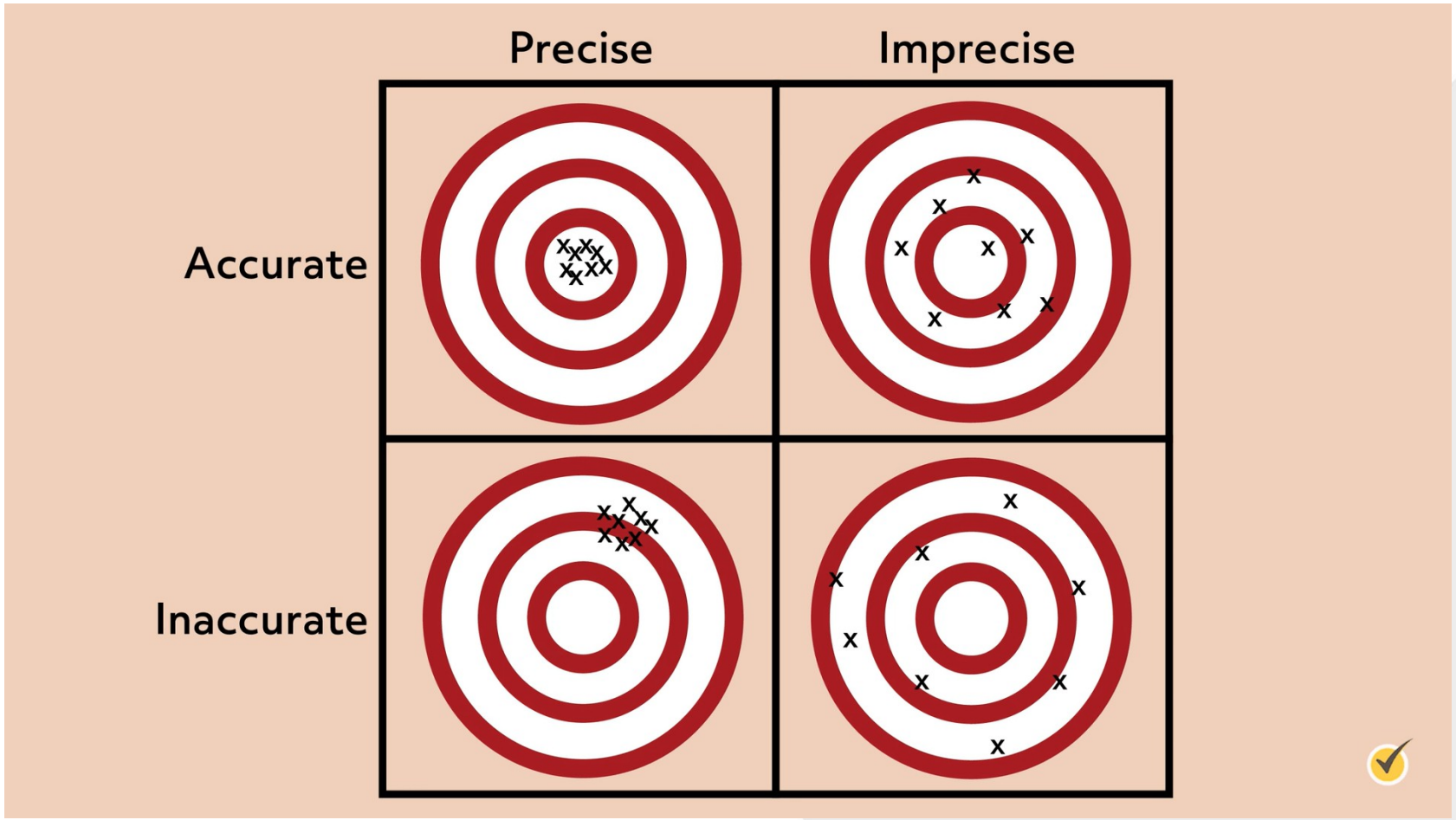
Advantages of having an Equipment assurance program in your laboratory

- Equipment is costly and doing maintenance can extend the life of equipment before replacing.
  - Reduces downtime of equipment failure.
  - Reduces breakdowns/faults
  - Increase productivity.
- To determine when equipment may need maintenance
  - Check for any drifts/variations/discrepancies.
  - Traceability.
- Accuracy and Precision
- Data integrity
- Ensures that calibrations on equipment are done to a competent standard.
- Accreditation compliance
- Safety

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Accuracy and Precision review



Precision

- Refers to how close repeated measurements are to one another.
  - It is about how often we get the same result.
- If the measurement is **consistent,** it is considered to be more reliable.
- Laboratory equipment will have an acceptance criteria for the limits of the acceptable range.

Accuracy

- Refers to how close a measurement comes to the true or actual measurement of the object.
- It describes how close the data is to the true value.

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Random vs. systematic error

What is the process if instrument/ equipment calibration checks PASS or FAIL?

- Record data and calibration status
- Update equipment register,

'in use' status

- Label instrument/ equipment
- Equipment fit for use
  - Continue in use

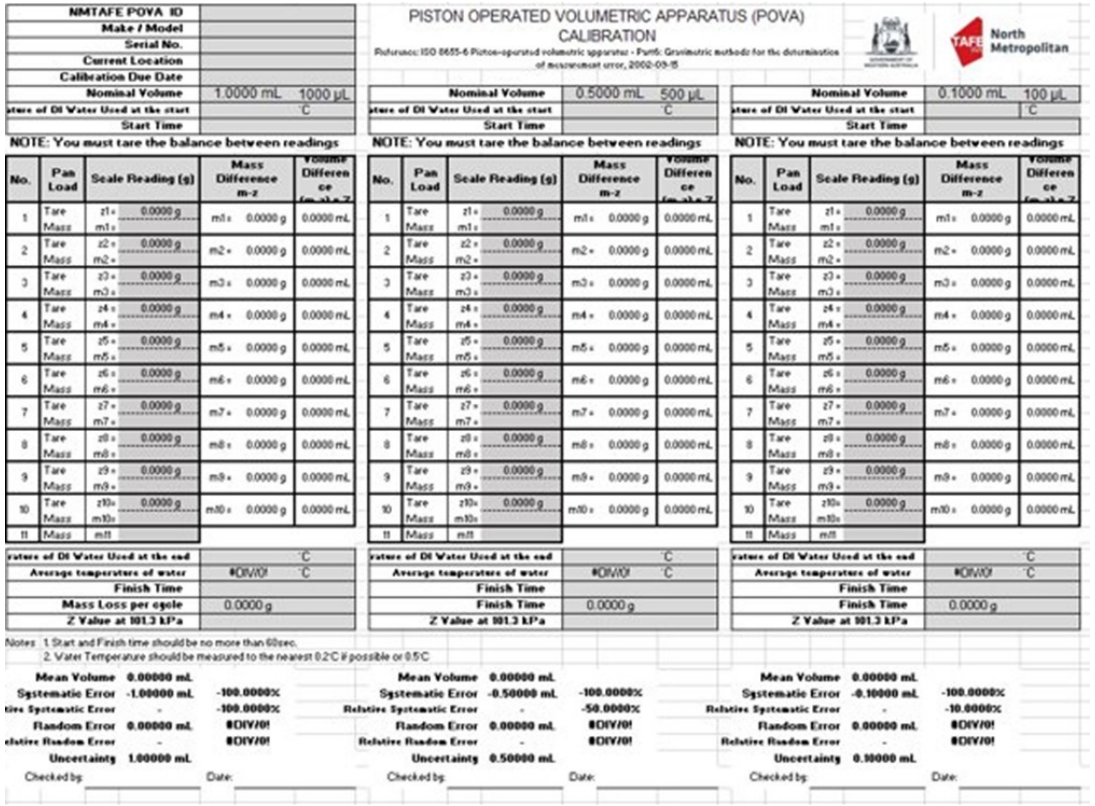
- Perform basic troubleshooting
- Record data and calibration status
- Report to Supervisor
- Tagging out
- Update equipment register,

'out of service' status

Auto-pipette. Piston Operated Volumetric Apparatus (POVA)

ASSESSMENT TASK 1b: (POVA)

- ❑ Practical observation, for POVA volume checks continue.
- ❑ ***Perform*** "Relace/repair" and cleaning steps



PISTON OPERATED VOLUMETRIC APPARATUS (POVA) CALIBRATION

NMTAFE POVA ID	
Make / Model	
Serial No.	
Current Location	
Calibration Due Date	
Nominal Volume	1.0000 mL 1000 µL
Nominal Volume	0.5000 mL 500 µL
Nominal Volume	0.1000 mL 100 µL

NOTE: You must tare the balance between readings

No.	Pan Load	Scale Reading (g)	Mass Difference m-z	Volume Difference
1	Tare Mass	z1 = 0.0000 g m1 =	m1 = 0.0000 g	0.0000 mL
2	Tare Mass	z2 = 0.0000 g m2 =	m2 = 0.0000 g	0.0000 mL
3	Tare Mass	z3 = 0.0000 g m3 =	m3 = 0.0000 g	0.0000 mL
4	Tare Mass	z4 = 0.0000 g m4 =	m4 = 0.0000 g	0.0000 mL
5	Tare Mass	z5 = 0.0000 g m5 =	m5 = 0.0000 g	0.0000 mL
6	Tare Mass	z6 = 0.0000 g m6 =	m6 = 0.0000 g	0.0000 mL
7	Tare Mass	z7 = 0.0000 g m7 =	m7 = 0.0000 g	0.0000 mL
8	Tare Mass	z8 = 0.0000 g m8 =	m8 = 0.0000 g	0.0000 mL
9	Tare Mass	z9 = 0.0000 g m9 =	m9 = 0.0000 g	0.0000 mL
10	Tare Mass	z10 = 0.0000 g m10 =	m10 = 0.0000 g	0.0000 mL
11	Mass	m11		

Average temperature of water	#DIV/0! °C
Finish Time	
Mass Loss per cycle	0.0000 g
Z Value at 101.3 kPa	

Notes: 1. Start and Finish time should be no more than 60sec.
2. Water Temperature should be measured to the nearest 0.2°C if possible or 0.5°C

Mean Volume	0.00000 mL		
Systematic Error	-1.00000 mL	-100.0000%	
Relative Systematic Error	-	-100.0000%	
Random Error	0.00000 mL	#DIV/0!	
Relative Random Error	-	#DIV/0!	
Uncertainty	1.00000 mL		

Mean Volume	0.00000 mL		
Systematic Error	-0.50000 mL	-100.0000%	
Relative Systematic Error	-	-50.0000%	
Random Error	0.00000 mL	#DIV/0!	
Relative Random Error	-	#DIV/0!	
Uncertainty	0.50000 mL		

Mean Volume	0.00000 mL		
Systematic Error	-0.10000 mL	-100.0000%	
Relative Systematic Error	-	-10.0000%	
Random Error	0.00000 mL	#DIV/0!	
Relative Random Error	-	#DIV/0!	
Uncertainty	0.10000 mL		

Checked by: Date:

7.1.14 Greasing the piston and cylinder

The piston or cylinder in the pipette lower part must be regreased after cleaning or decontamination.

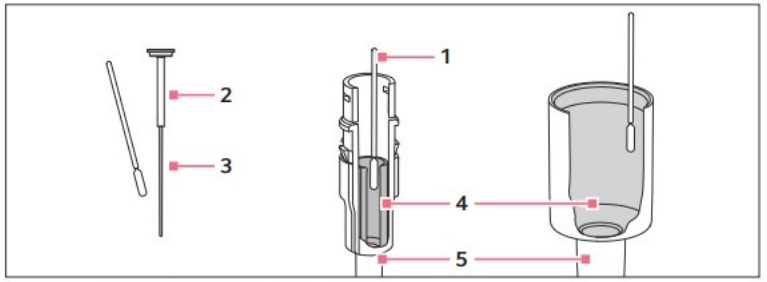


Fig. 7-4: Greasing the piston and cylinder

1	Swab	4	Cylinder
2	Piston ≤ 20 µL	5	Lower part > 20 µL
3	Running surface		

Greasing the piston

Prerequisites:

- For volumes ≤ 20 µL
- The pipette lower part has been disassembled.

1. Apply a small amount of grease to the swab.
2. Apply a thin layer of grease to the piston running surface. The pipette lower part can be reassembled.

** Refer to specific manufacturer manual*

Sources that can contribute to uncertainty **in the operation** of instruments/equipment?

Balance

- Environment,
  - Draft/ Airflow
  - Temperature variation
- Objects not at room temperature, being too hot or too cold
- Balance not level
- Readings drift
  - Draft shields not closed

POVA

- Incorrect tip used or poorly fitted tip
- POVA dripping
- Out of calibration
- Incorrect volume dispensed

How to manage sources that can contribute to uncertainty **in the operation** of instruments/equipment?

Balance

- Environment,
  - Draft/ Airflow:
  - Temperature variation
- Objects not at room temperature
- Balance not level
- Readings drift
  - Draft shields not closed

POVA

- Incorrect tip used or poorly fitted tip
- POVA dripping
- Out of calibration
- Incorrect volume dispensed

Common sources of faults in the instruments or equipment used and details of their repair

Common Faults	Examples of typical issues that may happen when the fault occurs
Wear and Tear	**Sticking** or **jamming** of moving **parts**, resulting in • inaccurate readings or • failure to operate. **Loosening** of connections or clips, leading to misalignment of components. **Physical damage**, compromising the integrity of the instrument.
Electrical/ Electronic Component Failure	**Sensor malfunction** leading to • inaccurate measurements or • Signal/power distortion. **Circuit failure** resulting in • intermittent operation, or • complete instrument shutdown.

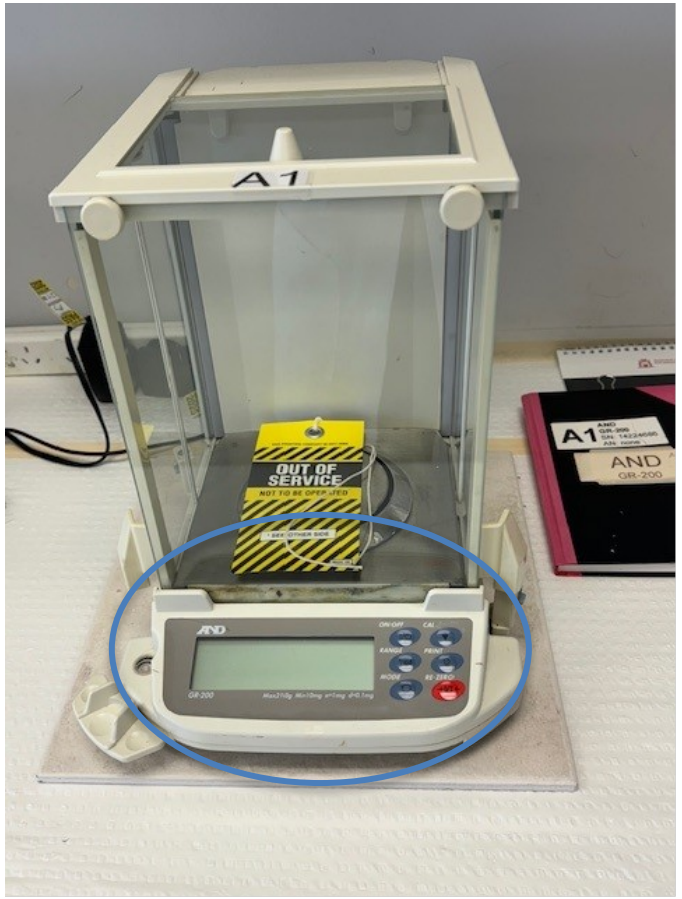
Common sources of faults in the instruments or equipment used and details of their repair

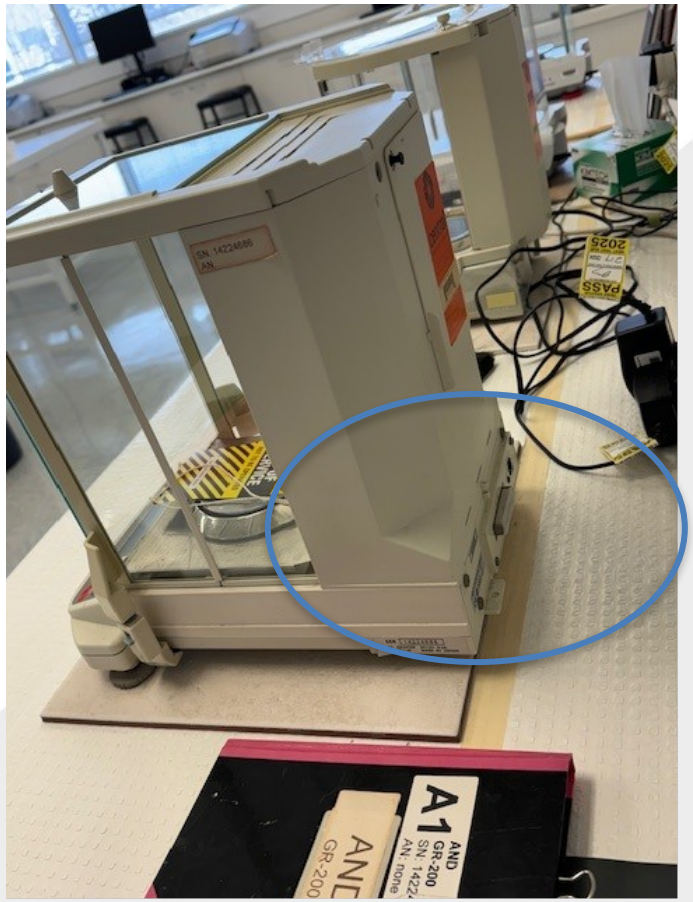
Common Faults	Typical issues that may happen when the fault occurs
Improper Handling or Usage causing damage/malfunction	**Rough handling** causing physical damage, misalignment, or distortion of components. **Failure to follow** operating instructions or recommended maintenance schedules resulting in decreased performance or premature failure. **Exposure to inappropriate** conditions or environments (e.g., exceeding specified temperature limits) causing damage or malfunction.

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Common sources of faults example





Electronic Component Failure

List of steps required when dealing with faulty equipment within the laboratory.

Steps required when dealing with faulty equipment within the laboratory.

1. Turn off and isolate from energy source (electrical, gas, hydraulics), if safe to do so.
2. Report to supervisor/manager in the work area
3. Tag out, Out of Service tag
    A. Date
    B. Time
    C. Person that tagged out equipment
    D. Information about the fault.
4. Any other warning signs
5. Update Instrument/maintenance logbook
5. Remove from lab, if possible, or temporary barricading

Arrange any reordering of consumable stocks and equipment components

NM TAFE Laboratory

Work Instruction

Equipment maintenance and repair

Document Number: **WI-001**

Author Pina Caminiti **Date Released** 14/08/2024

1. PURPOSE

Describes the steps that should be taken when calibration, repair, or maintenance of an instrument/equipment, within NMTAFE Laboratory, is required.

2. SCOPE

This work instruction provides guidance on a systematic approach to resolving instrument/equipment issues, repairs and/or maintenance. Technical staff can make informed decisions based on technical and financial considerations while ensuring procedural requirements are met.

3. SAFETY

3.0 Hazards within this method do not extend beyond general laboratory practice.
3.1 All chemicals should be considered hazardous. Refer to the Safety Data Sheets (SDS) where necessary. Avoid direct physical contact and handle safely

Answer questions below

I. Steps to arrange for the calibration, repair, or maintenance of this equipment.

II. How to identify and select a suitable subcontractor or organisation accredited to calibrate, service/repair laboratory equipment?

   a. What criteria should you consider when evaluating the accreditation and qualifications of the service agent?

III. Explain how you ensure that the maintenance/repair performed by the subcontractor meets the required standards and regulations?

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Activities!!

Assessment 1c - Communication - Approved suppliers and service technicians

Supplier communication- Part A

The assessment is comprised of 2 parts (Part A and Part B).

Equipment to be considered –

- Analytical balance (failed Repeatability or Monthly Single Point check),
- UV-Vis (lamp replacement, cuvette),
- pH Meter (electrode, fill solution, buffers).

PART A

In any laboratory the proper functioning of equipment is critical to maintaining production and reporting deadlines.

As such, to ensure that laboratories remain operational they need to have instructions in place when there are equipment breakdowns to ensure minimal loss of production.

1. List the steps required when dealing with faulty equipment within the laboratory.
2. Fill in the checklist/template provided and upload.

PART A

Consider the following:

- Perform basic troubleshooting
- Reporting of fault
- Tagging out
- Short sharp summary of problem encountered
- Model and make of equipment

Supplier communication- Part A (ii)

Equipment to be considered -

Analytical balance (failed Repeatability or Monthly Single Point check)

UV-Vis (lamp replacement, cuvette) **or**

pH Meter (electrode, fill solution, buffers).

Find **info** on
- Instrument,
- Instrument Manuals &
- Online

OFFICIAL

Checklist-Communication-Approved suppliers and service technicians

Part A(ii): Fill checklist to collect information required when communicating with a service technician.

Name of Equipment/Instrument	
Model	
Serial number	
In warranty *or* **Service contract details**	
Location on NMTAFE premises **Building:** **Level:** **Room number:**	
Problem or Issue (Brief and precise) What is wrong, How did it happen and When did it happen.	

Supplier communication- Part B

PART B

Communicating with NMTAFE Technical Support Officer who will contact the approved supplier about the required parts for equipment

No matter what business you are in, you often have to send e-mails, either placing or acknowledging orders.

This type of correspondence offers you an opportunity to convey professionalism and communicate.

Send a formal email or letter to the NMTAFE Technical Support Officer requesting to order parts for a specific laboratory equipment. - ***(Upload a copy of the email)***

The following information will be required to form part of this email:

1. *Your name and job title and contact details*
2. *Serial numbers, model and name of equipment/instrument*
3. *A short description of what consumable/parts are required (part #'s)*
4. *Whether or not a service contract exists (Is the equipment/instrument under warranty)*
5. *Quantities required*
6. *Date required*
7. *Subcontractor contact details*
8. *Request a quote with estimated price*

Supplier communication- Part B

Send | From | pina.caminiti@nmtafe.wa.edu.au | To | Cc | Subject: UV-Vis Shimadzu Model 1800- Tungsten Part No: 062-560505-00

Dear Jacob,

As discussed, we urgently need to order the following part for UV-Vis Shimadzu Model 1800 (Cat. No 206-25400-28), Serial No: A11635070617 AU.

- Tungsten Part No: 062-560505-00 (qty 2)

From the details recorded in the equipment logbook and equipment register the instrument is not under warranty (purchased in May 2013).

Please contact Walker Scientific, (08) 9409 3853, and request a formal quote for the above-mentioned part, with an ETA.
Once the quote has been provided, I can request a purchase order and forward the details to you.

The machine is vital for our production; therefore, I would like to receive the part as soon as possible preferably before 1st April 2024.

Thank you!

Regards,

Pina Caminiti
Laboratory Technician

North Metropolitan TAFE Laboratory
140 Royal St, East Perth
E pina.caminiti@nmtafe.wa.edu.au

Example

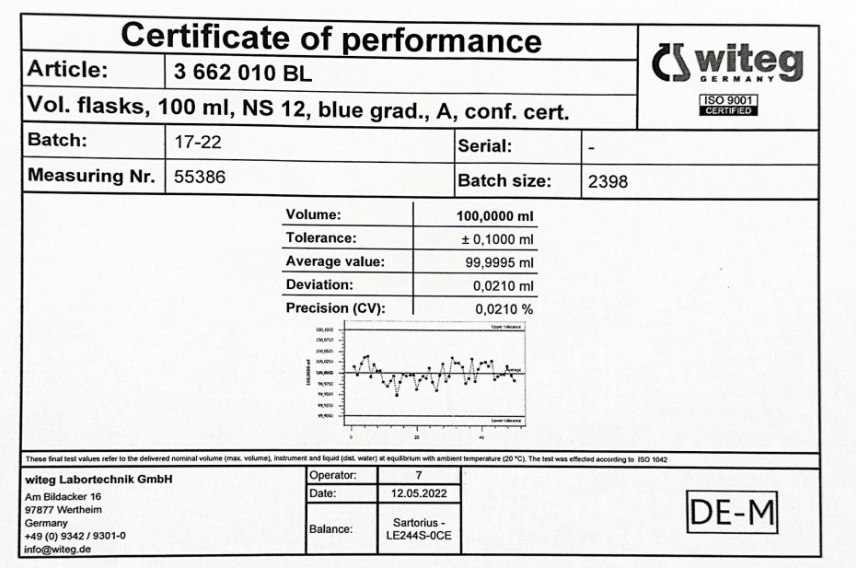
GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Volumetric Glassware Verification
AS2162.1-1996; ASTM E 542: 2022; ISO 4787: 2021

Volumetric Flask- The volumetric flask is used for preparation of solutions of definite concentrations for laboratory purposes.

- Critical glassware
- NATA accreditation requirement



Certificate of performance

witeg GERMANY ISO 9001 CERTIFIED

Article:	3 662 010 BL		
Vol. flasks, 100 ml, NS 12, blue grad., A, conf. cert.			
Batch:	17-22	Serial:	-
Measuring Nr.	55386	Batch size:	2398

Volume:	100,0000 ml
Tolerance:	± 0,1000 ml
Average value:	99,9995 ml
Deviation:	0,0210 ml
Precision (CV):	0,0210 %

These final test values refer to the delivered nominal volume (max. volume), instrument and liquid (dist. water) at equilibrium with ambient temperature (20 °C). The test was effected according to ISO 1042

witeg Labortechnik GmbH
Am Bildacker 16
97877 Wertheim
Germany
+49 (0) 9342 / 9301-0
info@witeg.de

Operator:	7
Date:	12.05.2022
Balance:	Sartorius - LE244S-0CE

DE-M

Item of equipment	Calibration interval (years)	Checking interval (months)	General comments and example reference standards
Torque transducers			
			EURAMET cg-14
Velocity transducers			
	3		
		24	Compare frequency response and sensitivity
Volumetric glassware			
	Initial (on commissioning) 10 (borosilicate) 5 (soda-lime)		EURAMET cg-19 ISO 4787 ASTM E542, E694 Where glassware is subject to harsh treatment such as high temperatures or corrosive substances the calibration period may need to be reduced.

GOVERNMENT OF WESTERN AUSTRALIA

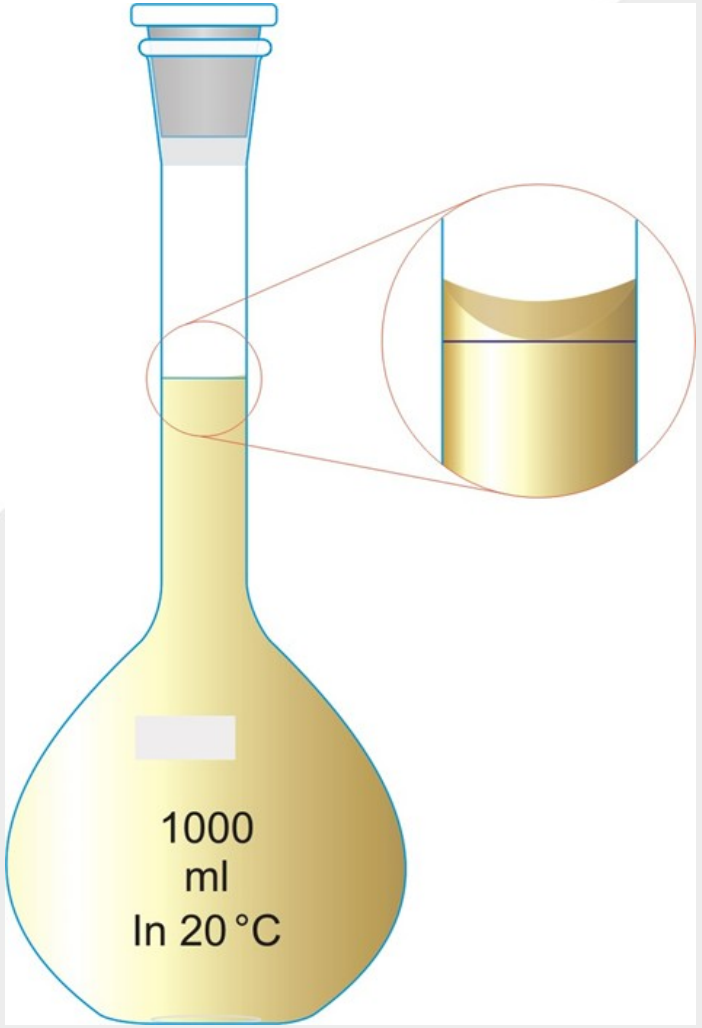
TAFE WA North Metropolitan

Volumetric Glassware Verification
AS2162.1-1996; ASTM E 542: 2022; ISO 4787:2021

Factors affecting Accuracy of volumetric glassware

- The cleanliness and proper conditioning of glass surface
- Temperature
- Setting of meniscus
- Errors in weighing.

How to manage factors?



GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Volumetric Glassware Verification
AS2162.1-1996; ASTM E 542: 2022; ISO 4787: 2021

CALCULATION FOR THE CALIBRATION CHECK OF: VOLUMETRIC FLASKS

Date:		Location:	
Glassware Identification:		Balanced used:	
Performed by:		Checked by:	

Nominal Volume Dispensed (mL):			Water Density:		
Replicate No.	Empty volumetric glassware$^{(z)}$	Volumetric glassware + dispensed $^{(m)}$	Weight Dispensed $^{(z-m)}$		
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
Water Temp. ^{0}C:		5		±	g $^{95\%}$
z factor:		Calculated Vol.Dispensed:		±	mL $^{95\%}$
Nominal Accuracy Criteria (+/-):	1.0%	Accuracy (%):			
Tolerance for this apparatus (+/-):	1.0%	Tolerance (%):			
Comments:			Thermometer used:		

Assessment Task 1e Volumetric Glassware

Perform verification of the calibrated volume of 2 flasks,

- *1x 100ml flask and*
- *1x 50ml flask.*

Today's Session: Session 9

- *Recap*- Calibration Curve for Permanganate (Exercise 4, pages 35 to 39)

- Introduction to Recording and Reporting requirements
  - Procedure PR-EP-NMTLAB-0103

- Activity- Method comparison and validation (Exercise 5)

- Revision for Assessment Task 2-Knowledge

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Recap Calibration Curve for Permanganate

Review questions

1. Why is it essential to consider the error associated with glass pipettes and volumetric flasks when preparing standards, and how does this impact the accuracy of the calibration curve?

2.

   i. How does scanning a standard via **Spectrum** mode help identify the λmax (wavelength of maximum absorbance) for potassium permanganate? and

   ii. Why is it relevant to set the instrument to this λmax during the experiment?

Recap Calibration Curve for Permanganate

3.

i. What is the linear range?

ii. Why is it important that the calibration curve be linear?

iii. Calculate the Method Detection Limit (MDL) and Limit of Reporting (LOR).

- Method Detection Limit (MDL)
- Limit of Reporting (LOR)

Recap Calibration Curve for Permanganate

Method Detection Limit (MDL) and Limit of Reporting (LOR)

- **Detection vs. Quantification:**
  - MDL indicates the method's ability to detect the presence of an analyte.
  - LOR is applied to quantify analyte reliably.
- **Concentration Levels:**
  - The MDL is lower (~2.5 times) than the LOR.
- **Reporting:**
  - At concentrations between the MDL and LOR, the analyte can be detected but cannot be reliably quantified.
  - Below the MDL, the analyte cannot be detected,
  - Concentrations above the LOR can be confidently reported as accurate concentrations.

Recap Calibration Curve for Permanganate

4.

i. Discuss possible reasons for any points not lying on the line.

ii. Did you notice any relationship to the %error of your dilution?

5. Calculate Relative Percent Difference (RPD) for your duplicate standard.

Precision (duplicates) **RPD (%)** = $\frac{|x_1 - x_2|}{\text{Ave}(x_1, x_2)} \times 100$

X_1 is Working Standard

X_2 is Duplicate Working Standard

Recording, reporting and document control requirements.

ISO/IEC 17025

Figure B.1 illustrates an example of a possible schematic representation of the operational processes of a laboratory, as described in Clause 7.

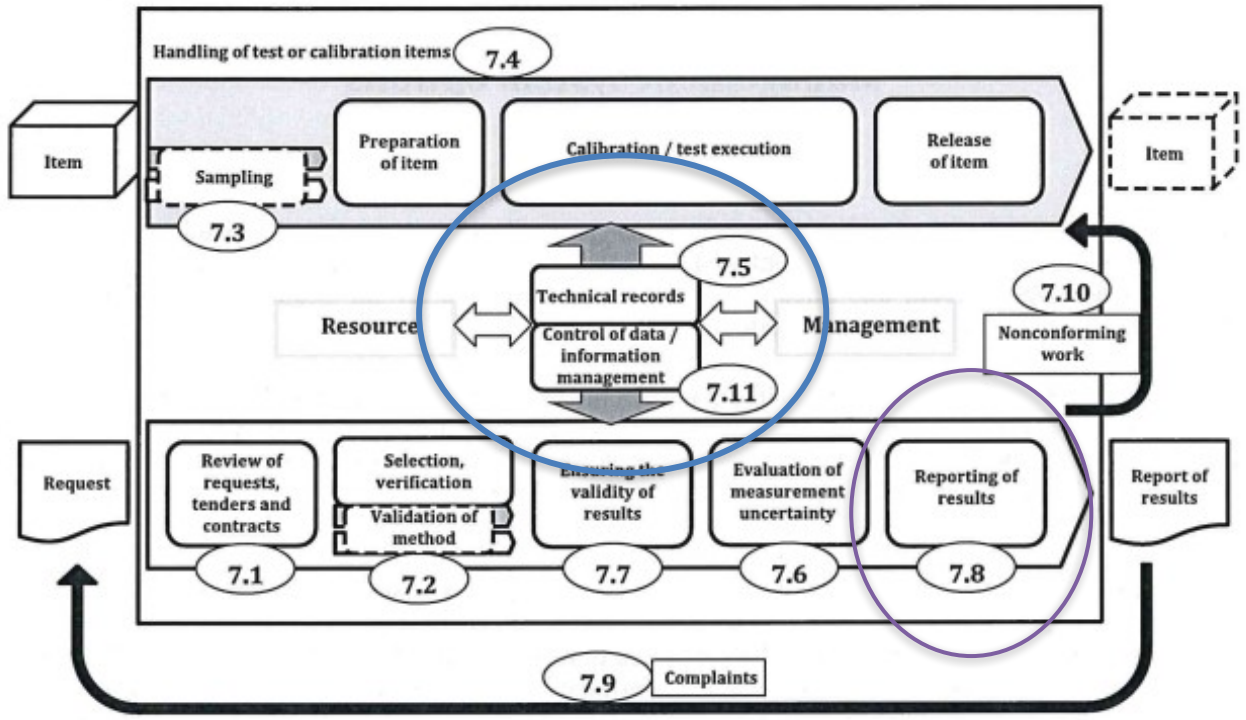


Figure B.1 — Possible schematic representation of the operational processes of a laboratory

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Recording, reporting and document control requirements.

OFFICIAL

Government of Western Australia
North Metropolitan TAFE

Recording and Reporting Procedure

1. SCOPE

The purpose of this procedure is to detail recording and reporting requirements to be followed when reporting results to the clients, based on ISO/IEC 17025.

2. PROCEDURE

2.1 Identification of Client Requirements:

- Begin by understanding the specific requirements and expectations of the client regarding the testing services, refer to Chain of Custody (CoC).
- Document all relevant information such as
  - sample type,
  - testing parameters,
  - turnaround time,
  - reporting format, and any special instructions provided by the client.

2.2 Sample Reception:

- Upon receipt of the sample, ensure proper labelling, handling, and storage according to procedures.
- Record all appropriate information about the sample, including unique identification numbers, date and time of receipt, condition upon arrival, and any discrepancies noted.

2.3 Testing Procedure:

- Perform testing procedures following documented methods and standard operating procedures (SOPs) approved by the laboratory's quality management system.
- Ensure that all testing equipment is calibrated and maintained as per equipment schedule and ISO/IEC 17025 requirements

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Analytical Report Examples

QUICKSILVER SCIENTIFIC

Elemental Analysis - Whole Blood
by Inductively Coupled Plasma/Mass Spectrometry
[redacted]
Lab Director: Christopher W. Shade, PhD

Jane Doe

Practitioner: John Doe
Date Of Birth: 2/6/1971

Dates	Taken	Arrived	Analyzed
Present	7/21/2021	8/2/2021	8/10/2021
Previous	12/7/2017	12/12/2017	1/3/2018

Nutrient Elements

Element	Results	Prior	Recommended Limit	Units	Percentile Rank by Quintile (10 20 30 40 50 60 70 80 90)	Percentile
Calcium (Ca)	5.25	5.38	4.7 - 6.4	mg/dL		27%
Copper (Cu)	87	80	63 - 113	µg/dL		47%
Lithium (Li)	0.8	179.4	< 0.1 - 21	µg/L		42%
Magnesium (Mg)	3.35	3.30	2.93 - 4.17	mg/dL		30%
Manganese (Mn)	7.3	6.3	4.26 - 14.3	µg/L		26%
Molybdenum (Mo)	2.2	0.3 B	< 0.2 - 1.9	µg/L		99%
Selenium (Se)	196	155	79 - 362	µg/L		39%
Zinc (Zn)	583	564	454 - 745	µg/dL		43%

Whole Blood Element Ratios

Element	Results	Prior	Recommended Limit	Units	Percentile Rank by Quintile (10 20 30 40 50 60 70 80 90)	Percentile
Ca/Mg Ratio	1.57	1.630	1.20-1.99	NA		46%
Cu/Zn Ratio	0.149	0.14	0.09-0.21	NA		48%

Toxic Elements

Element	Results	Prior	Recommended Limit	Units	Percentile Rank by Quintile (10 20 30 40 50 60 70 80 90)	Percentile
Antimony (Sb)	3.9	NA	< 7.0	µg/L		32%
Arsenic (As)	1.2	0.3 B	< 6.3	µg/L		37%
Cadmium (Cd)	0.2 B	0.2 B	< 0.74	µg/L		33%
Lead (Pb)	1.02	1.31	< 2.34	µg/dL		41%
Mercury (Hg)	1 B	0.9 B	< 5.8	µg/L		33%

Potentially Toxic Elements

Element	Results	Prior	Recommended Limit	Units	Percentile Rank by Quintile (10 20 30 40 50 60 70 80 90)	Percentile
Cobalt (Co)	0.3 B	0.2 B	< 2.0	µg/L		50%
Silver (Ag)	0.2 B	< 0.1	< 2.6	µg/L		49%
Strontium (Sr)	23	23	< 470	µg/L		48%

These test results are not intended for the diagnosis of disease. They are intended for interpretation by qualified healthcare professionals with a full knowledge of patient history to assist in their administration of an appropriate healthcare regimen.

1960 Cherry Street [redacted]

Comprehensive Neurotransmitter; urine

DOCTOR'S DATA, INC.

Order: U000000-0000-0
DOCTOR:
Client #: 1234
Doctor's Data, Inc.
3755 Illinois Ave.
St. Charles, IL 60174 U.S.A.

Patient: Sample Report
Id: Sample-I-02219
Age: 56 **DOB:** 07/17/1963
Sex: Female
Body Mass Index (BMI): N/A

Sample Collection	Date/Time
Date Collected	11/31/2019
Wake Up Time	06:00
Collection Period	2nd morning void
Date Received	12/06/2019
Date Reported	12/16/2019

Analyte	Result	Unit per Creatinine	L	WRI	H	Reference Interval
Phenethylamine (PEA)	101	nmol/g				42 – 160
Tyrosine	197	µmol/g				70 – 180
Tyramine	5.4	µmol/g				2.8 – 8.5
Dopamine	272	µg/g				175 – 500
3,4-Dihydroxyphenylacetic acid (DOPAC)	898	µg/g				540 – 1850
3-Methoxytyramine (3-MT)	288	nmol/g				122 – 278
Norepinephrine	45.5	µg/g				29 – 69
Normetanephrine	176	µg/g				112 – 400
Epinephrine	8.2	µg/g				2.1 – 14.5
Metanephrine	102	µg/g				60 – 158
Norepinephrine / Epinephrine ratio	5.6					< 13
Tryptamine	0.35	µmol/g				0.65 – 1.6
Serotonin	29.8	µg/g				79 – 235
5-Hydroxyindoleacetic acid (5-HIAA)	1583	µg/g				2500 – 9000
Glutamate	22	µmol/g				18.0 – 70.0
Gamma-aminobutyrate (GABA)	6.3	µmol/g				2.6 – 8.0
Glycine	3636	µmol/g				700 – 2500
Histamine	41	µg/g				14 – 51
Taurine	1448	µmol/g				420 – 1400
Creatinine	13.4	mg/dL				25 – 180

Neurotransmitter Comments:

- Urinary neurotransmitter levels provide an overall assessment of the body's ability to make and break down neurotransmitters and are representative of whole body levels. Neurotransmitters are secreted all through the body, in neurons of both the central and peripheral nervous systems. The enzymes, cofactors and precursors in neurotransmitter metabolism in general are the same in the periphery and in the central nervous system. Therefore, alterations in urinary neurotransmitter levels assessed in urine provide important clinical information, and may be associated with many symptoms including cognitive and mood concerns, diminished drive, fatigue and sleep difficulties, cravings, addictions and pain.
- Tyrosine is the non-essential amino acid precursor for dopamine, norepinephrine and epinephrine. Increased tyrosine may exacerbate migraine headaches and hyperthyroid conditions. Elevated tyrosine levels may occur due to supplementation (phenylalanine or tyrosine), heritable enzyme defects, or liver disease. Tyrosine hydroxylase converts tyrosine into the dopamine precursor L-DOPA; BH4, Vitamin D and iron are cofactors for that enzymatic activity.

Notes:
Results are creatinine corrected to account for urine dilution variations. Creatinine is not meant to be used as an indicator of renal function.
Ref= Reference Interval, L (blue)= Low (below RI), WRI (green)= Within RI (optimal), WRI (yellow)= Within RI (not optimal), H (red)= High (above RI)
Methodology: LC/MS QQQ Creatinine by Jaffe Reaction

Analyzed by DOCTOR'S DATA, INC. • 3755 Illinois Avenue, St. Charles, IL 60174-2420 USA • LAB DIR: Eric Roth, MD • CLIA ID: 14D0646470

TÜVRheinland®
Precisely Right.

CERTIFICATE

Of Conformity of Pneumatic Proof Test
FOR STAINLESS STEEL GAUGE COCK

ORDER NO. : **166225433**

CERTIFICATE NO. : **166225433-005**

NAME OF MANUFACTURER : M/s. DAWSONS-TECH COMPONENTS LLP
Unit No. DD - 6 & 7, Khan Real Industrial Estate,
N. H. 08, Pelhar, Vasai Phata, Vasai (East),
Dist. Palghar - 401208, Maharashtra, INDIA.

Testing Parameters :

1. Test Medium : Nitrogen Gas
2. Pressure Rating / Test Pressure : 25 Bar (368 PSIG) / 30 Bar (435 PSIG)
3. Test Pressure variations : ± 5 % Bar (PSIG)
4. Pressure Gauge : Calibration Certificate reviewed
5. Temperature During Test : 20^{O} C to 40^{O} C
6. Material of Construction : SS316
7. Verification of material properties : Material test certificate reviewed
8. Verification of Dimensions : Verified inspection report with relevant drawing of each components
9. Time for monitoring leakage : 3 minutes
10. Quantity of each size of Gauge Cock : 3 Nos

Procedure of Pneumatic Proof Test :
As per DAWSONS-TECH Pneumatic Proof Test procedure Reference No. DT-PNT-VALVE-00.

Test Result :
The test result shown below for the Pneumatic Proof Test is carried out as per above procedure.

End Connection		Tested Valve No.	Recorded Tested Pressure Bar (PSIG)	Result
Type	Size			
Male to Female BSP	1/4"	VGC01-MF4G/SS-1	32 (464)	PASS*
		VGC01-MF4G/SS-2	35 (507)	PASS*
		VGC01-MF4G/SS-3	30 (435)	PASS*
Male to Female BSP	1/2"	VGC01-MF8G/SS-1	35 (507)	PASS*
		VGC01-MF8G/SS-2	32 (464)	PASS*
		VGC01-MF8G/SS-3	33 (478)	PASS*

PASS* : No leakage detected during the test.

Comments : DAWSONS-TECH Stainless Steel Gauge Cock Series : VGC01 meets the requirements of Pneumatic Proof Test.

For, **TUV Rheinland (India) Pvt. Ltd.**

Malcolm Dadina
(General Manager - Industrial Services)

Date : 28/01/2020

TUV Rheinland (India) Pvt. Ltd. D.S Business Galleria Office no – 1209 12th Floor, L.B.S Marg Kanjurmarg (W) Mumbai, Maharashtra 400 078, India Telefon:-+91 80 46498214

Activities

- Assessment Task 3 (page 30)
- Method comparison and validation (Exercise 5) (pages 40 to 42)
  - PDCA
- Revision for Assessment Task 2

Today's Session: Session 10

ASSESSMENT TASK 2 (Knowledge)

MSL934008 Maintain instruments and equipment.

- Recap- Method comparison and validation (Exercise 5)

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

MSL934008 Maintain and calibrate instruments and equipment
MSL934009 Apply Quality Systems and Continuous Improvement Processes

Assessment Task 2

Mobile phones turned off and place in Bag/carrier

Place pens on your desk and put your bag/carrier under your desk.

Your bag/carrier must remain under your chair until you have completed the examination, and you are told that you may leave the room.

No talking or attempting to communicate verbally or non-verbally in any manner with another student or person;

Any questions, ask me.

Hand in completed written papers by the end of assessment time.

GOOD LUCK!!

Assessment 2

https://www.timeanddate.com/worldclock/australia/perth

Activities

- Assessment Task 3 (pages 30)
- Method comparison and validation (Exercise 5) (pages 43 to 47)

Recap- Method comparison and validation

Review questions

1. In reviewing % Accuracy error results and applying the criteria of ±0.5%, which alternative cuvette would be acceptable?

2. What reasons would lead an organisation to perform this type of method validation?

3. What efficiencies could be gained from the changes?

4. Refer to exercise 1, identify an appropriate quality tool and complete.

GOVERNMENT OF WESTERN AUSTRALIA

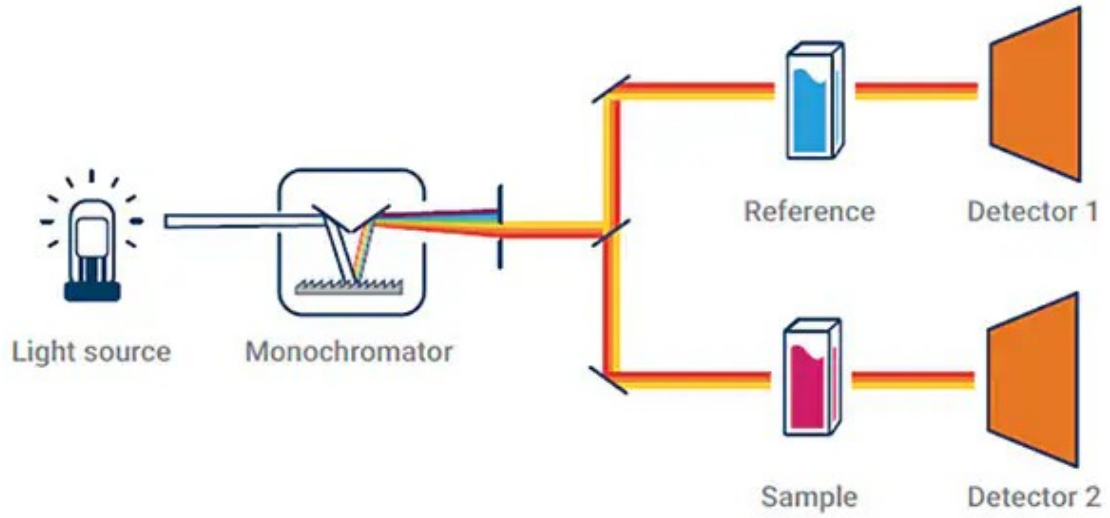
TAFE WA North Metropolitan

Session 8

MSL934008 Maintain instruments and equipment
MSL934009 Apply Quality Systems and Continuous Improvement Processes

Session 7 review

- UV-Vis spectrophotometry
- Control chart procedure



Activities:

- **ASSESSMENT TASK 1b: (POVA)** Practical observation, for POVA *Task "Replace/repair" and cleaning steps completed*
- **ASSESSMENT TASK 1e:** Volumetric Glassware
- Control chart readings for **TASK 3** Control Chart (Portfolio) (page 30-31)
- Fixed Wavelength Measurements, Exercise 3. (pages 32-34)

Today's Session

- Quantitative Analysis
  - Preparation of standards
  - Dilution Tables and
  - Calibration curves.

- Calibration Curve for Permanganate (Exercise 4)

Discuss AT3-Control Chart Portfolio

- What Absorbance values did you record for 0.4g/L K_2CrO_4?

Chart updates

- Review date setting
- Set limits (Mean, UCL, LCL) based on ‘Historical data’ (Sem 1 2024 data)

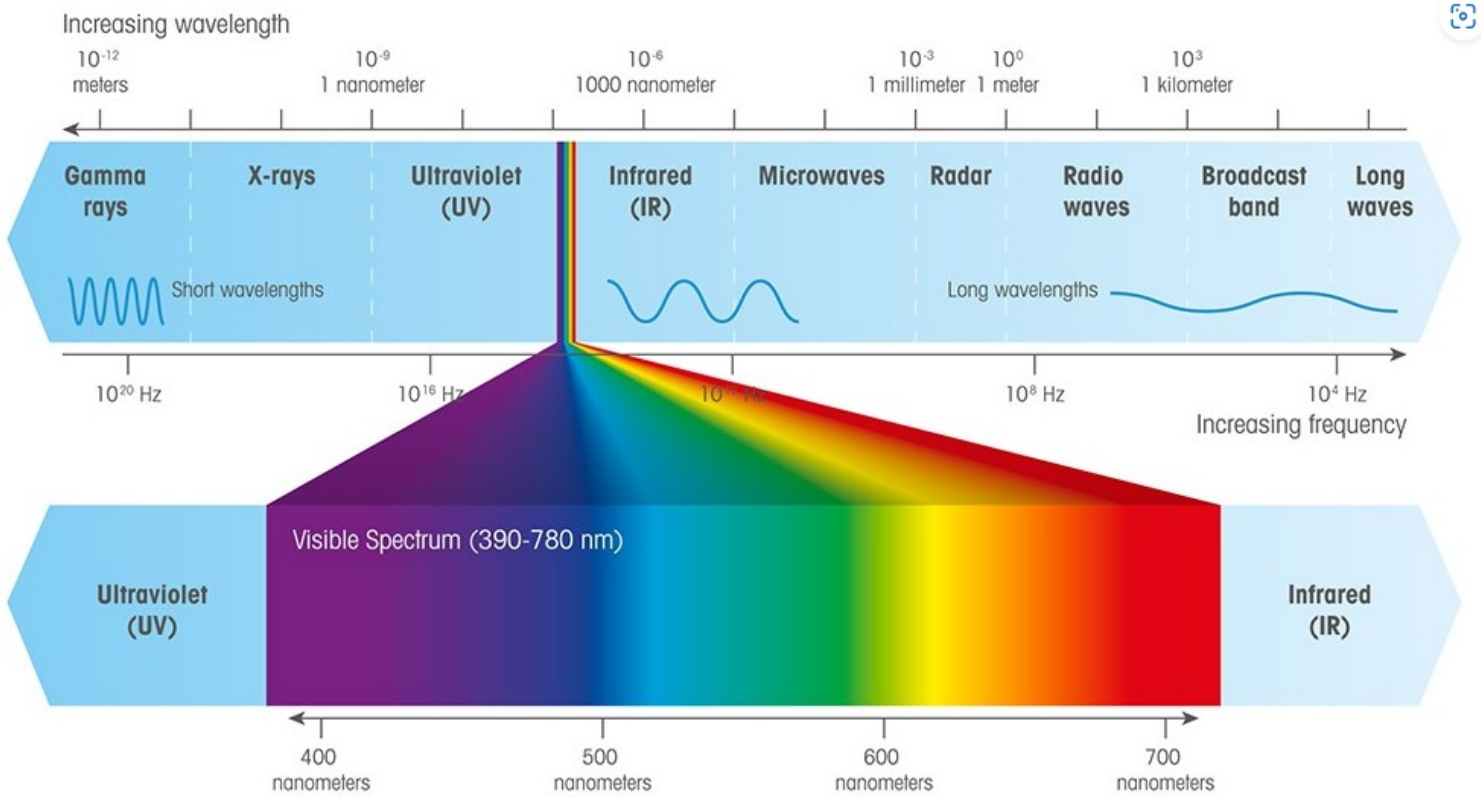
GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Recap Fixed Wavelength Measurements

Discuss

- Fixed Wavelength Measurements, Exercise 3.
  - Instrument set up
  - Blank
    - Cuvette preparation
  - Prepare sample
    - Sample ID
  - Analysis
  - Clean up



Review questions

1. How does the measured absorbance of the Photometric Standard compare with the expected value? Is the difference significant?

2. Do different instruments produce different results? Why?

3. Explain the purpose of doing ‘instrument zero’ at the beginning of each analysis.

GOVERNMENT OF WESTERN AUSTRALIA

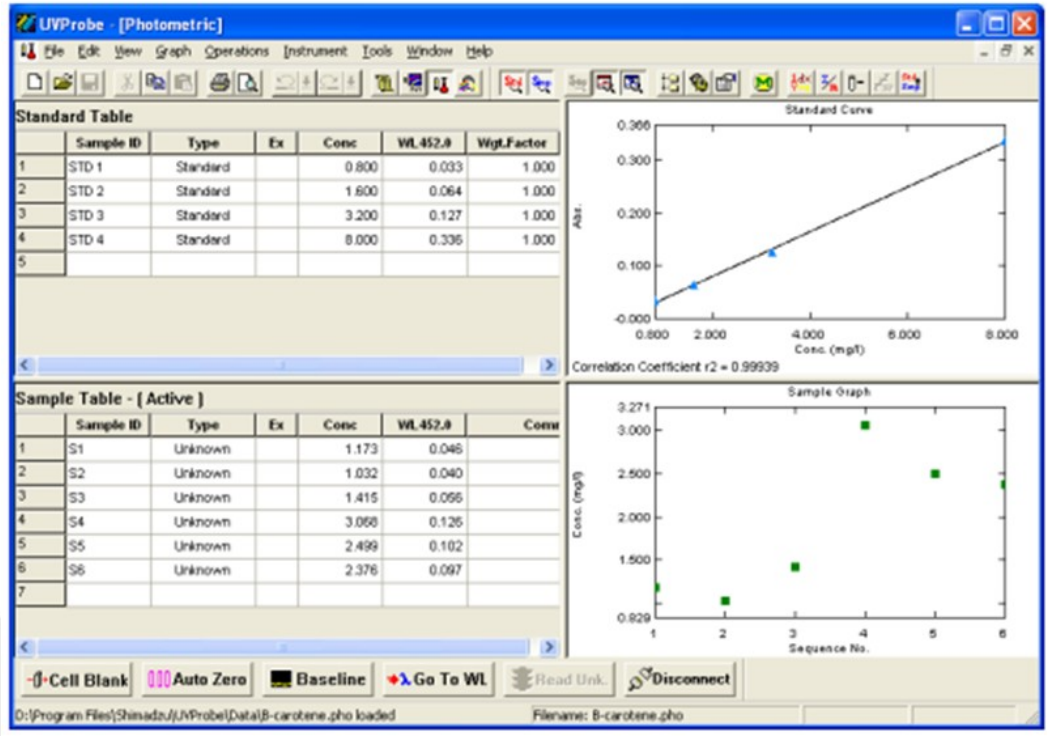
TAFE WA North Metropolitan

Quality Control Presentation and QAQC plan

Quantitative Analysis

Definition: Quantitative analysis is an analytical method to determine a unknown concentration of analyte in a sample.

To do this, an instrument response is measured using a range of standards and the line of best fit through the standards is called the ‘Calibration Curve’.


UVProbe - [Photometric]
File Edit View Graph Operations Instrument Tools Window Help
Standard Table
Sample ID Type Ex Conc WL:452.0 Wgt.Factor
1 STD 1 Standard 0.800 0.033 1.000
2 STD 2 Standard 1.600 0.064 1.000
3 STD 3 Standard 3.200 0.127 1.000
4 STD 4 Standard 8.000 0.336 1.000
Standard Curve
Abs
Conc. (mg/l)
Correlation Coefficient r2 = 0.99939
Sample Table - [Active]
Sample ID Type Ex Conc WL:452.0
1 S1 Unknown 1.173 0.046
2 S2 Unknown 1.032 0.040
3 S3 Unknown 1.415 0.056
4 S4 Unknown 3.068 0.126
5 S5 Unknown 2.499 0.102
6 S6 Unknown 2.376 0.097
Sample Graph
Conc. (mg/l)
Sequence No.
Cell Blank
Auto Zero
Baseline
Go To WL
Read Unk.
Disconnect
D:\Program Files\Shimadzu\UVProbe\Data\B-carotene.pho loaded
Filename: B-carotene.pho

- Calibration Standards provide the basis for quantitation for most instrumental techniques.
- The equation of this line is then used to calculate the unknown amount in the sample.

Instrument response

The response of an instrument maybe Absorbance, transmittance, current, intensity, counts, etc..

Instrument response used in **quantitative analysis** is proportional to the concentration of an analyte in solution (the most common example is Beer's Law).

- In this course we will use UV-Vis Spectrometry (or Spectrophotometry) and measure Absorbance as the response.
- As a rule, instruments are not stable over long periods of time or when turning off and on again, therefore, we run standards every time with the samples.

Beer-Lambert Law

The law is expressed by the equation: $A = \varepsilon * c * l$

Where:

- **A** is the absorbance of the solution, a dimensionless quantity that indicates how much light is absorbed by the sample.
- **ε** (epsilon) is the molar absorptivity or molar extinction coefficient, a constant that describes how strongly a substance absorbs light at a particular wavelength. It has units of L/(mol cm) and depends on the specific substance and the wavelength of light.
- **c** is the concentration of the absorbing substance in the solution, measured in mol/L (molarity).
- **l** is the path length of the cuvette through which the light passes, measured in centimetres.

Metrological standard

The reference to standards in a laboratory often refers to an actual chemical or physical material called a **metrological standard**.

A metrological standard is a ‘known’ to which an ‘unknown’ can be measured.

Basic Steps:

- Prepare a range of standards
- Create a calibration curve
- Determine line of best fit and correlation coefficient R^2
- Calculate unknown sample concentrations

How to prepare a range of standards

Metrological standards fall into different hierarchal levels:

- Primary standards
  - Primary Calibration and Quality control standards are derived from two (2) main sources,
    - **Purchased** stock solutions that have a **certified** concentration of the target analytes and **traceable** or
    - those that are "**manufactured**" **in-house** from high purity or Analytical Reagent grade materials and chemicals.

If the material is a **certified reference material**, then it must be accompanied by a certificate which includes information on the material's stability, homogeneity, traceability, and uncertainty (2,3: ISO 30 & 17024).

- Secondary/intermediate standards
  - Prepared from Primary standard. To create secondary standards traceable to a primary standard.

- Working standards
  - Prepared from Secondary standards
  - Used for instrument calibration.

How to prepare a range of standards

When preparing a range of **calibration standards**, it's essential to follow best practices to ensure accurate and reliable results.

Here are some tips for creating effective calibration standards:

1. **Use Equipment Correctly**: While most methods define the compounds and concentrations needed for standards, they often don't provide specific instructions for mixing standards. Ensure you use equipment correctly during the preparation process.

   How to pipette accurately

   – Review how to use Bulb Pipettes accurately

2. **Consider Stability Issues**: When preparing working standard solutions, always use high-quality starting materials formulated for stability.

   Properly stored and stable standards are crucial for accurate calibration.

3. **Establish a standard Workflow**:

   Develop a consistent workflow for creating standards. Document your process, including measurements, calculations, and any adjustments made during preparation.

   Dilution calculations $C_1 V_1 = C_2 V_2$

How to create a calibration curve

- A series of standard solutions are prepared of known concentration range, covering the expected concentration of the analyte.

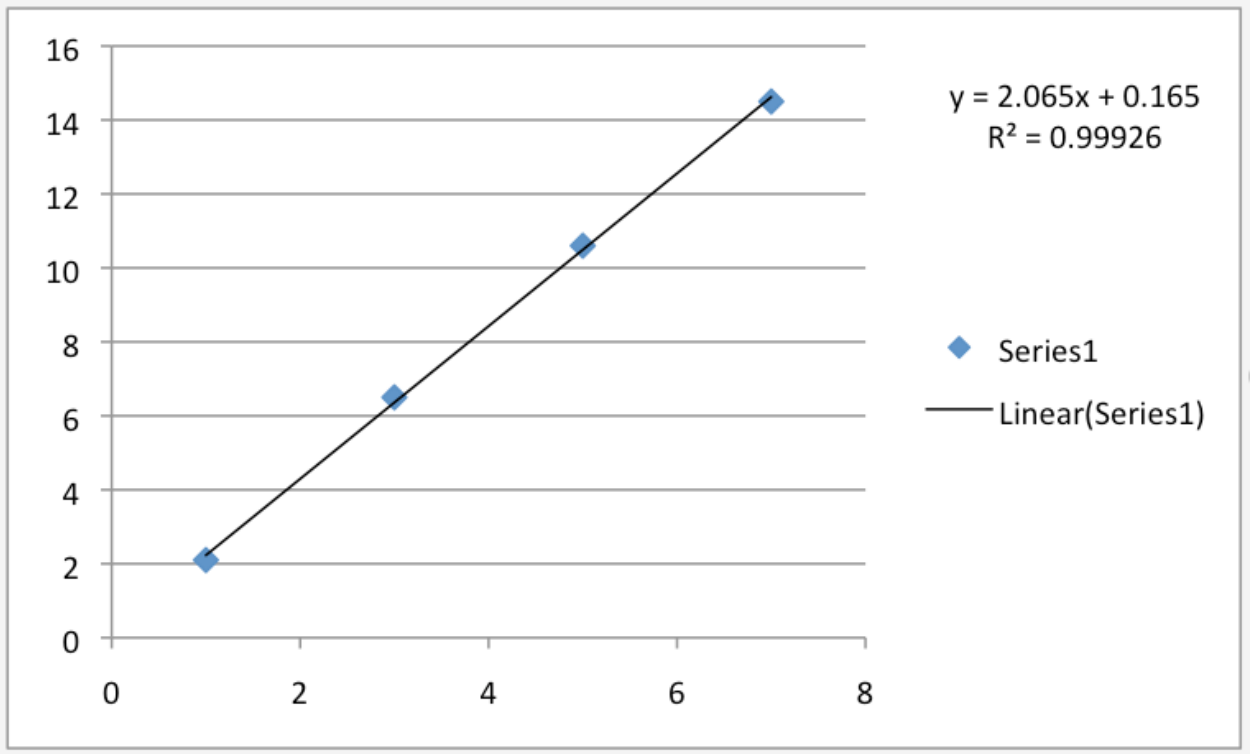
For example, if an unknown concentration is thought to be approximately 4 ppm, then a series of standards bracketing this value are prepared: 1, 3, 5, 7 ppm, or 2.5, 5, 7.5, 10ppm. The readout for each is then measured.

Sometimes the instrument is only linear over a certain concentration range.

- ➢ After calibration complete instrument performance verification
  - ❑ If all checks are within acceptance criteria samples can be analysed.

How to create a calibration curve

The calibration curve is a plot of readout (Abs.) vs concentration (Conc.).
The equation of the line (y) of best fit is given, including the slope and intercept.



Photometric Report

25/10/2023 05:37:47 PM

File Name: C:\Users\20089399\Desktop\iron analysis week 2 original file.pho

[Wavelengths]
Wavelength Name: WL510.0
Wavelength: 510.00 nm

[Calibration Curve]
Column for Cal. Curve: WL510.0
Cal. Curve Type: Multi Point
Cal. Curve Unit: mg/l
Selected Wavelength: WL510.0
Calibration Equation: Abs = K1*(Conc) + K0
Zero Interception: Not Selected

[Measurement Parameters(Standard)]
Data Acquired by: Instrument
Delay sample read: Disabled
Repeat: Disabled

[Measurement Parameters(Sample)]
Data Acquired by: Instrument
Delay sample read: Disabled
Repeat: Disabled

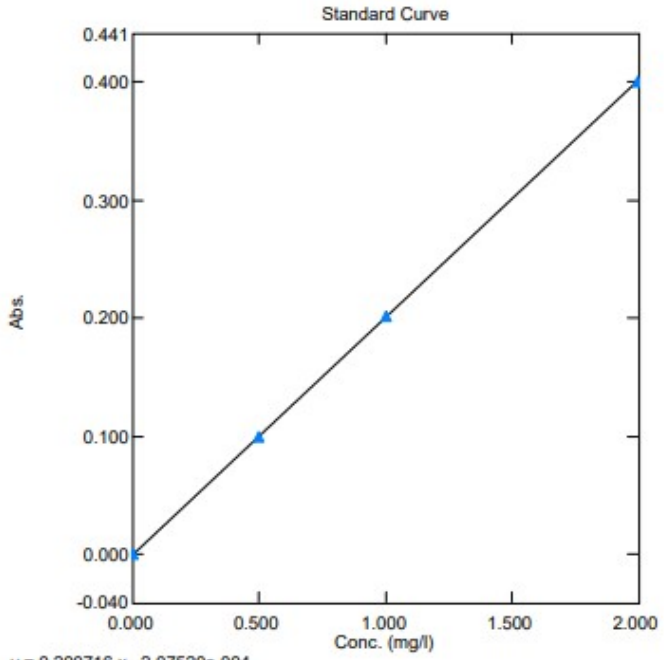
[Equations]

[Pass Fail]

[Method Summary]
Title:
Date/Time: 25/10/2023 04:47:21 PM
Comments:
Sample Preparations:

[Instrument Properties]
Instrument Type: UV-1800 Series
Measuring Mode: Absorbance
Slit Width: 1.0 nm
Light Source Change Wavelength: 340.0 nm
S/R Exchange: Normal

[Attachment Properties]



y = 0.200716 x - 2.07520e-004
r2 = 0.99999

Standard Table

	Sample ID	Type	Ex	Conc	WL510.0	Wgt.Factor	Comments
1	Blank	Standard		0.000	-0.000	1.000	
2	0.5	Standard	✔	0.500	0.000	1.000	
3	0.50	Standard		0.500	0.099	1.000	
4	1	Standard		1.000	0.201	1.000	
5	2	Standard		2.000	0.401	1.000	
6							

Calculating unknown sample concentration

Make sure the absorbance of the sample is within the range of the standards.

- That means, it is between the highest and lowest standard.
  - If sample is **over-range**, then the sample can be diluted and re-analysed.

Find the equation of the standards from the Calibration Curve and substitute the sample absorbance as **y**.

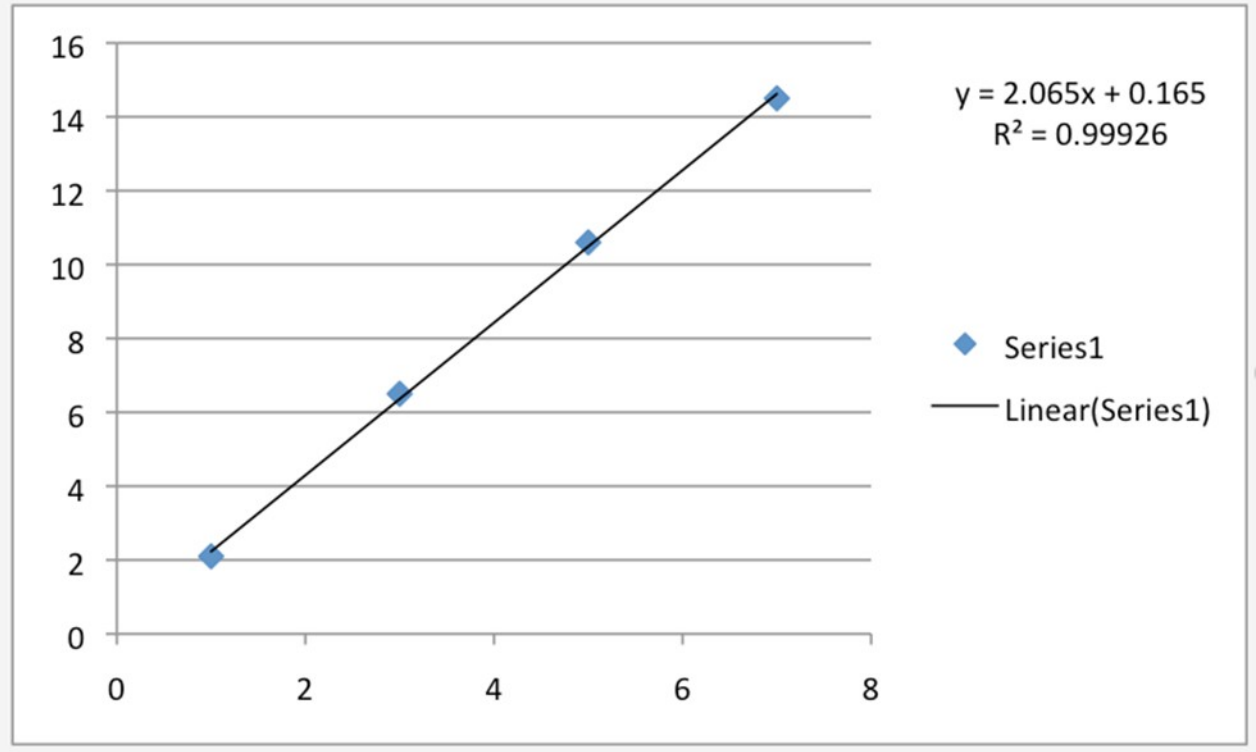
Eg: from the example above

$7.8 = 2.065x - 0.165$

$7.8 + 0.165 = 2.065x$

$(7.8+0.165) / 2.065 = x$

solving for **x** = 3.70 ppm



Activities

- Assessment Task 3 (page 30)
- Calibration Curve for Permanganate (Exercise 4) (pages 35-39)

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan

Session 5

MSL934008 Maintain instruments and equipment
MSL934009 Apply Quality Systems and Continuous Improvement Processes

Session 4 review

Auto-pipette (POVA)

- Work instruction,
- Safety, faults, inspect and clean POVA
- Calibration ISO 8655-6 (2022) and
- Calibration and calibration volume check requirements.

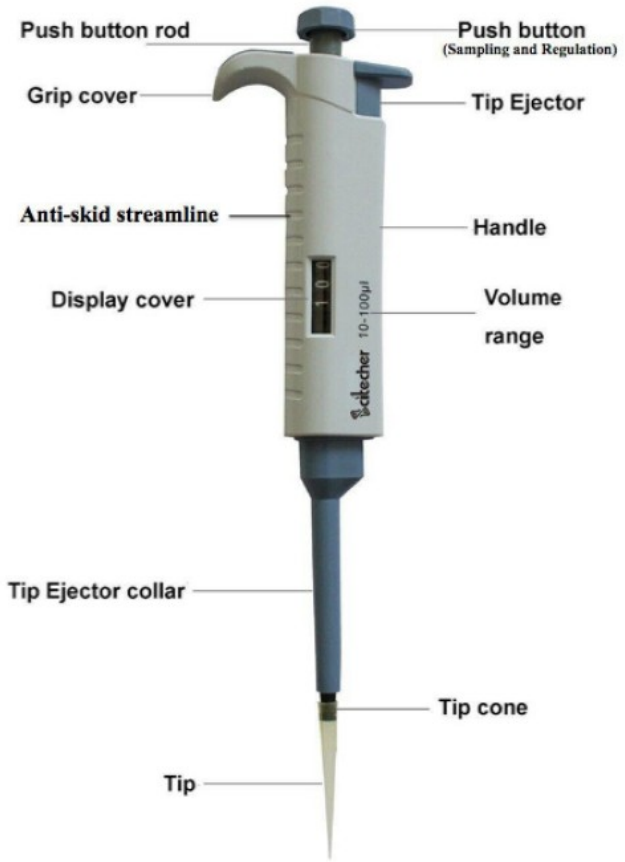
Today's Outcome

- **ASSESSMENT TASK 1b**: Piston Operated Volumetric Apparatus (POVA)
  - Calibration volume checks
  - Practical observations

- Autopipette procedure summary
- Continue working on 'Maintenance and Calibration Schedule'

Auto-pipette. Piston Operated Volumetric Apparatus (POVA)

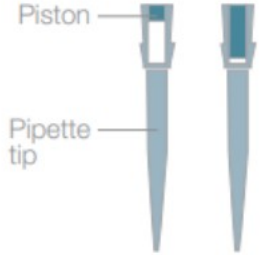
The Parts



- Pipette Variations – There are two types of pipettes
- Tip selection

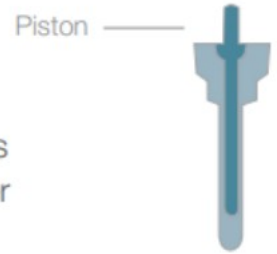
Air displacement pipettes:

Air displacement pipetting is highly accurate for standard pipetting applications. However, temperature and atmospheric pressure, as well as the specific gravity and viscosity of the solution, may affect the performance of air displacement pipettes.



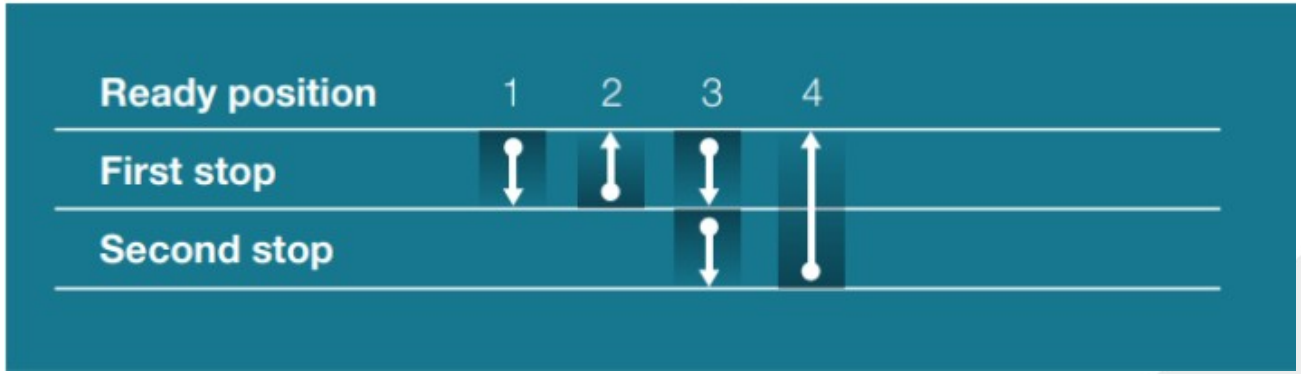
Positive displacement pipettes:

Positive displacement pipetting is based on direct contact of the piston with the liquid. The aspirated liquid amount depends on the dimensions of the cylinder or capillary and the movement distance of the piston. In positive displacement pipettes the tips contain both the cylinder/capillary and the piston.

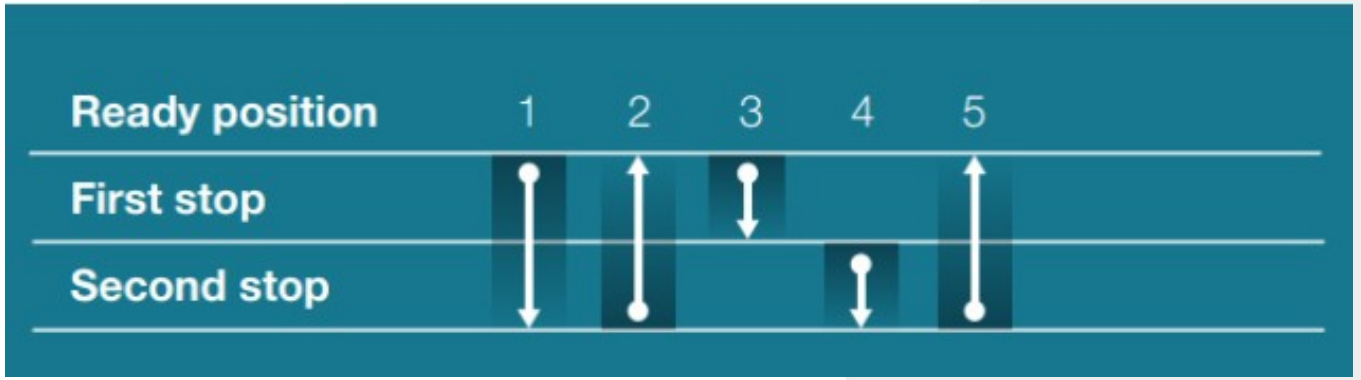


Auto-pipette. Piston Operated Volumetric Apparatus (POVA)

Proper Pipetting Techniques - Forward Technique



Proper Pipetting Techniques - Reverse Technique

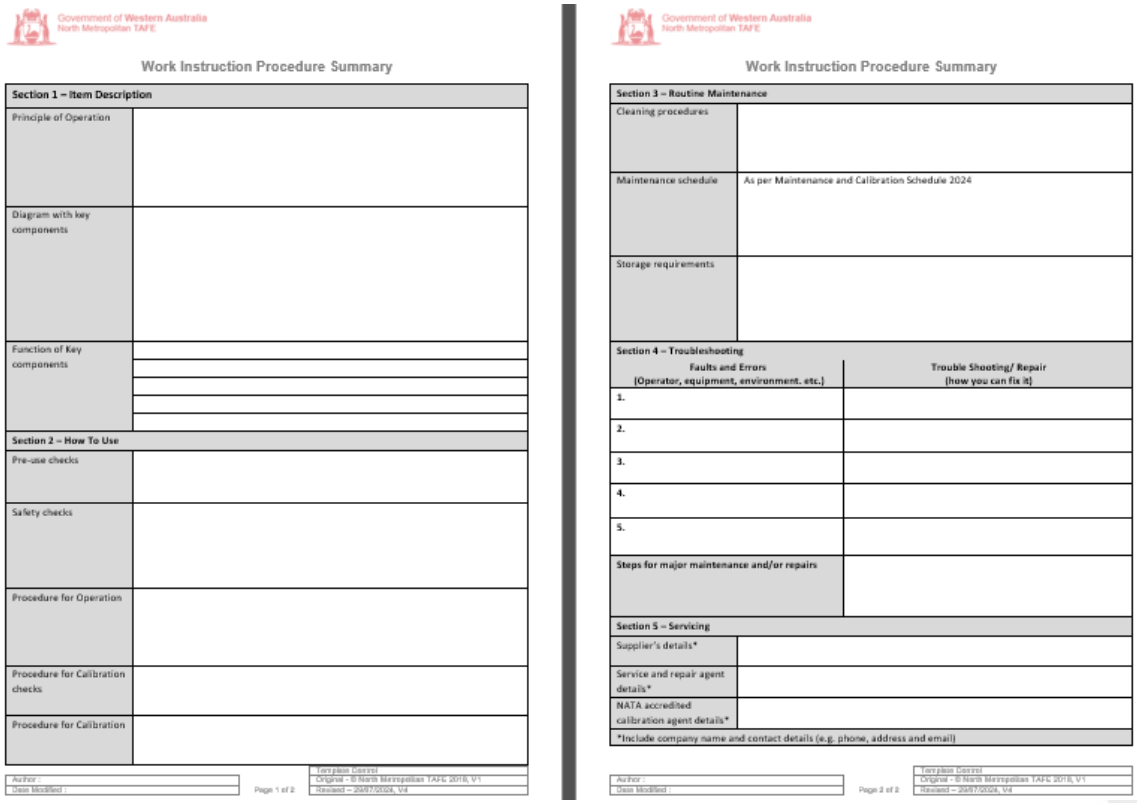


Auto-pipette. Piston Operated Volumetric Apparatus (POVA)

- Recommendations for pipetting liquids
- Check POVA is clean. If needed clean
- Check POVA in calibration
- Use tip in agreement with the manufacture's specifications.
  - Single use
- Follow same process of pipetting between samples
- Avoid turning POVA on side, with Tip
- Avoid contamination, use tip ejector
- Always store POVAs in an upright position, when not in use

Auto-pipette. Piston Operated Volumetric Apparatus (POVA)

Calibration of Piston-Operated Liquid Handling Instruments Webinar – '



Government of Western Australia
North Metropolitan TAFE

Work Instruction Procedure Summary

Section 1 – Item Description	
Principle of Operation	
Diagram with key components	
Function of Key components	
Section 2 – How To Use	
Pre-use checks	
Safety checks	
Procedure for Operation	
Procedure for Calibration checks	
Procedure for Calibration	

Author :
Date Modified :
Page 1 of 2
Template Control
Original - © North Metropolitan TAFE 2018, V1
Revised – 29/07/2024, V4

Government of Western Australia
North Metropolitan TAFE

Work Instruction Procedure Summary

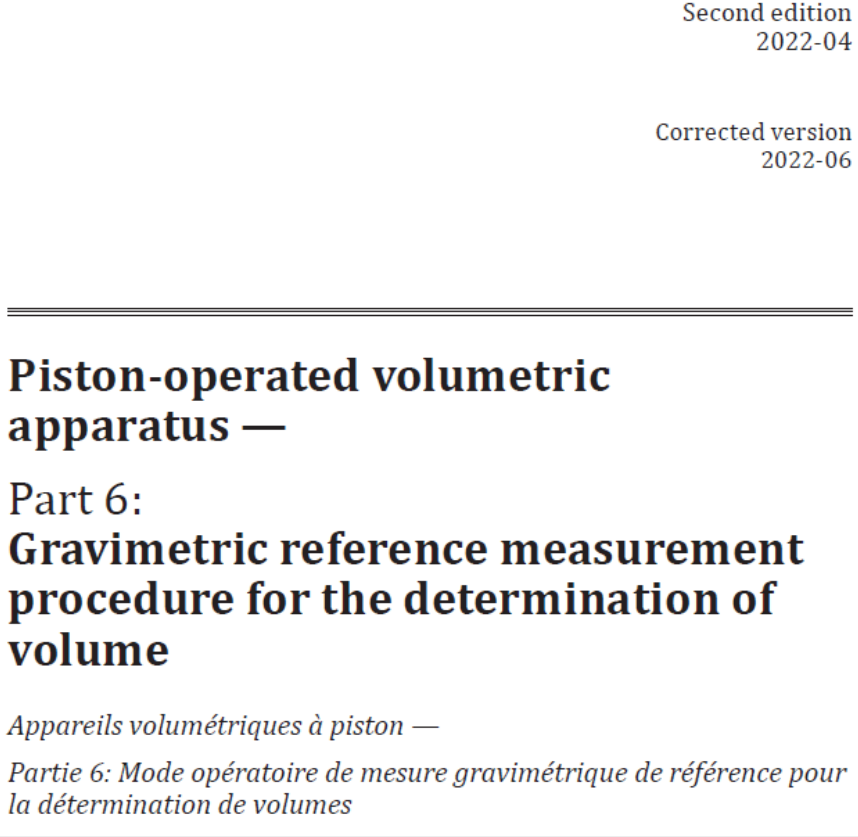
Section 3 – Routine Maintenance	
Cleaning procedures	
Maintenance schedule	As per Maintenance and Calibration Schedule 2024
Storage requirements	

Section 4 – Troubleshooting	
Faults and Errors (Operator, equipment, environment. etc.)	Trouble Shooting/ Repair (how you can fix it)
1.	
2.	
3.	
4.	
5.	
Steps for major maintenance and/or repairs	

Section 5 – Servicing	
Supplier's details*	
Service and repair agent details*	
NATA accredited calibration agent details*	

*Include company name and contact details (e.g. phone, address and email)

Author :
Date Modified :
Page 2 of 2
Template Control
Original - © North Metropolitan TAFE 2018, V1
Revised – 29/07/2024, V4



INTERNATIONAL STANDARD

ISO 8655-6

Second edition
2022-04

Corrected version
2022-06

Piston-operated volumetric apparatus —

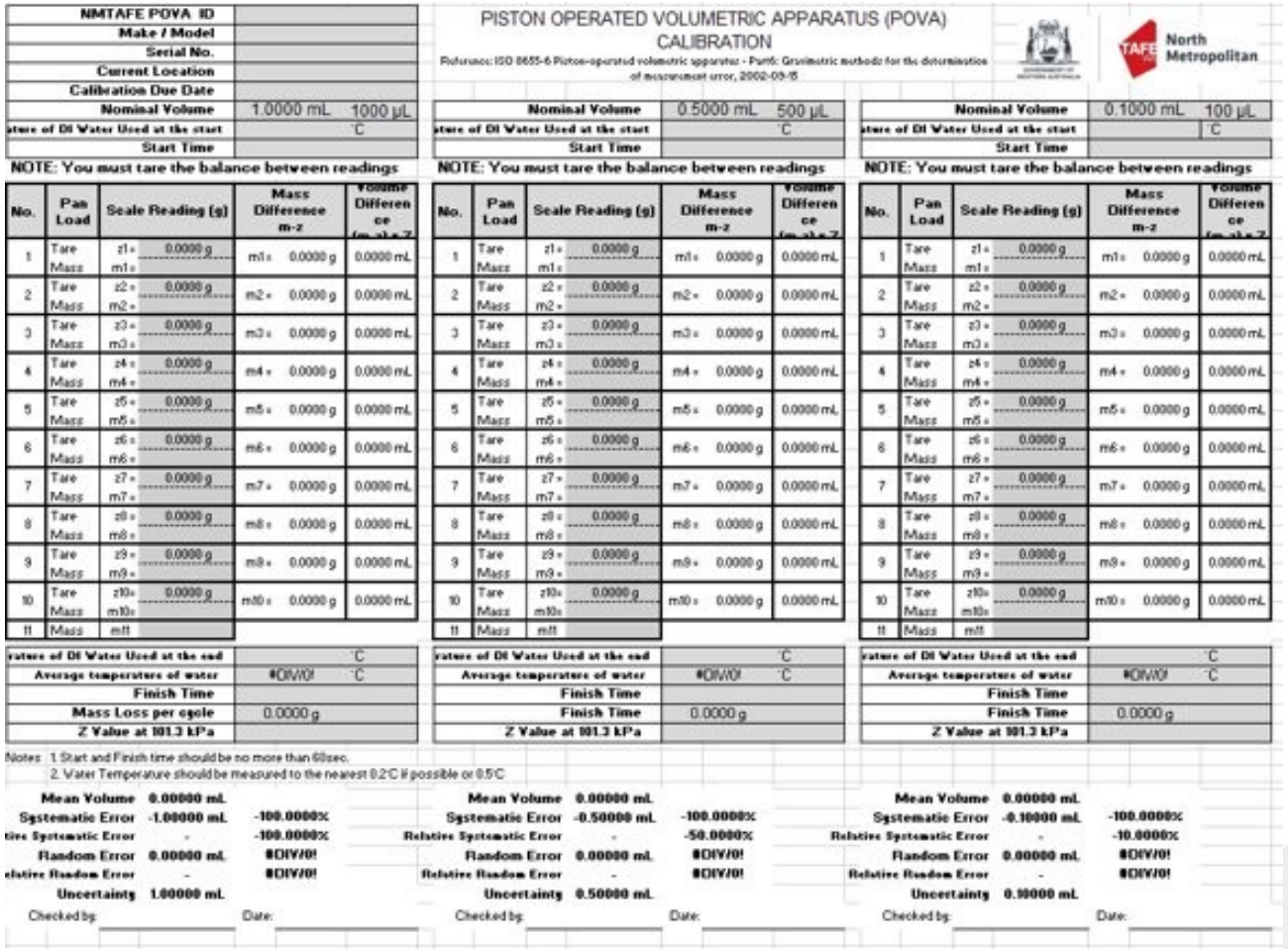
Part 6:
Gravimetric reference measurement procedure for the determination of volume

Appareils volumétriques à piston —

Partie 6: Mode opératoire de mesure gravimétrique de référence pour la détermination de volumes

GOVERNMENT OF WESTERN AUSTRALIA

TAFE WA North Metropolitan



PISTON OPERATED VOLUMETRIC APPARATUS (POVA)
CALIBRATION

NMTAFE POVA ID	
Make / Model	
Serial No.	
Current Location	
Calibration Due Date	
Nominal Volume	1.0000 mL 1000 µL
Temperature of DI Water Used at the start	°C
Start Time	

NOTE: You must tare the balance between readings

No.	Pan Load	Scale Reading (g)	Mass Difference m-z	Volume Difference
1	Tare Mass m1 =	z1 = 0.0000 g	m1 = 0.0000 g	0.0000 mL
2	Tare Mass m2 =	z2 = 0.0000 g	m2 = 0.0000 g	0.0000 mL
3	Tare Mass m3 =	z3 = 0.0000 g	m3 = 0.0000 g	0.0000 mL
4	Tare Mass m4 =	z4 = 0.0000 g	m4 = 0.0000 g	0.0000 mL
5	Tare Mass m5 =	z5 = 0.0000 g	m5 = 0.0000 g	0.0000 mL
6	Tare Mass m6 =	z6 = 0.0000 g	m6 = 0.0000 g	0.0000 mL
7	Tare Mass m7 =	z7 = 0.0000 g	m7 = 0.0000 g	0.0000 mL
8	Tare Mass m8 =	z8 = 0.0000 g	m8 = 0.0000 g	0.0000 mL
9	Tare Mass m9 =	z9 = 0.0000 g	m9 = 0.0000 g	0.0000 mL
10	Tare Mass m10 =	z10 = 0.0000 g	m10 = 0.0000 g	0.0000 mL
11	Mass m11			

Temperature of DI Water Used at the end	°C
Average temperature of water	#DIV/0! °C
Finish Time	
Mass Loss per cycle	0.0000 g
Z Value at 101.3 kPa	

Notes: 1. Start and Finish time should be no more than 60sec.
2. Water Temperature should be measured to the nearest 0.2°C if possible or 0.5°C

Mean Volume	0.00000 mL	
Systematic Error	-1.00000 mL	-100.0000%
Relative Systematic Error	-	-100.0000%
Random Error	0.00000 mL	#DIV/0!
Relative Random Error	-	#DIV/0!
Uncertainty	1.00000 mL	

Checked by: Date:

Nominal Volume	0.5000 mL 500 µL
Temperature of DI Water Used at the start	°C
Start Time	

NOTE: You must tare the balance between readings

No.	Pan Load	Scale Reading (g)	Mass Difference m-z	Volume Difference
1	Tare Mass m1 =	z1 = 0.0000 g	m1 = 0.0000 g	0.0000 mL
2	Tare Mass m2 =	z2 = 0.0000 g	m2 = 0.0000 g	0.0000 mL
3	Tare Mass m3 =	z3 = 0.0000 g	m3 = 0.0000 g	0.0000 mL
4	Tare Mass m4 =	z4 = 0.0000 g	m4 = 0.0000 g	0.0000 mL
5	Tare Mass m5 =	z5 = 0.0000 g	m5 = 0.0000 g	0.0000 mL
6	Tare Mass m6 =	z6 = 0.0000 g	m6 = 0.0000 g	0.0000 mL
7	Tare Mass m7 =	z7 = 0.0000 g	m7 = 0.0000 g	0.0000 mL
8	Tare Mass m8 =	z8 = 0.0000 g	m8 = 0.0000 g	0.0000 mL
9	Tare Mass m9 =	z9 = 0.0000 g	m9 = 0.0000 g	0.0000 mL
10	Tare Mass m10 =	z10 = 0.0000 g	m10 = 0.0000 g	0.0000 mL
11	Mass m11			

Temperature of DI Water Used at the end	°C
Average temperature of water	#DIV/0! °C
Finish Time	
Finish Time	0.0000 g
Z Value at 101.3 kPa	

Mean Volume	0.00000 mL	
Systematic Error	-0.50000 mL	-100.0000%
Relative Systematic Error	-	-50.0000%
Random Error	0.00000 mL	#DIV/0!
Relative Random Error	-	#DIV/0!
Uncertainty	0.50000 mL	

Checked by: Date:

Nominal Volume	0.1000 mL 100 µL
Temperature of DI Water Used at the start	°C
Start Time	

NOTE: You must tare the balance between readings

No.	Pan Load	Scale Reading (g)	Mass Difference m-z	Volume Difference
1	Tare Mass m1 =	z1 = 0.0000 g	m1 = 0.0000 g	0.0000 mL
2	Tare Mass m2 =	z2 = 0.0000 g	m2 = 0.0000 g	0.0000 mL
3	Tare Mass m3 =	z3 = 0.0000 g	m3 = 0.0000 g	0.0000 mL
4	Tare Mass m4 =	z4 = 0.0000 g	m4 = 0.0000 g	0.0000 mL
5	Tare Mass m5 =	z5 = 0.0000 g	m5 = 0.0000 g	0.0000 mL
6	Tare Mass m6 =	z6 = 0.0000 g	m6 = 0.0000 g	0.0000 mL
7	Tare Mass m7 =	z7 = 0.0000 g	m7 = 0.0000 g	0.0000 mL
8	Tare Mass m8 =	z8 = 0.0000 g	m8 = 0.0000 g	0.0000 mL
9	Tare Mass m9 =	z9 = 0.0000 g	m9 = 0.0000 g	0.0000 mL
10	Tare Mass m10 =	z10 = 0.0000 g	m10 = 0.0000 g	0.0000 mL
11	Mass m11			

Temperature of DI Water Used at the end	°C
Average temperature of water	#DIV/0! °C
Finish Time	
Finish Time	0.0000 g
Z Value at 101.3 kPa	

Mean Volume	0.00000 mL	
Systematic Error	-0.10000 mL	-100.0000%
Relative Systematic Error	-	-10.0000%
Random Error	0.00000 mL	#DIV/0!
Relative Random Error	-	#DIV/0!
Uncertainty	0.10000 mL	

Checked by: Date:

Let's go through the worksheet!

Equipment ready

- ✓ Temperature
- ✓ Humidity

- ✓ Check balance-Fit for purpose

- Volume -

Nominal (full), 50% and minimum (10%)

- Drip Test

Perform calibration volume checks